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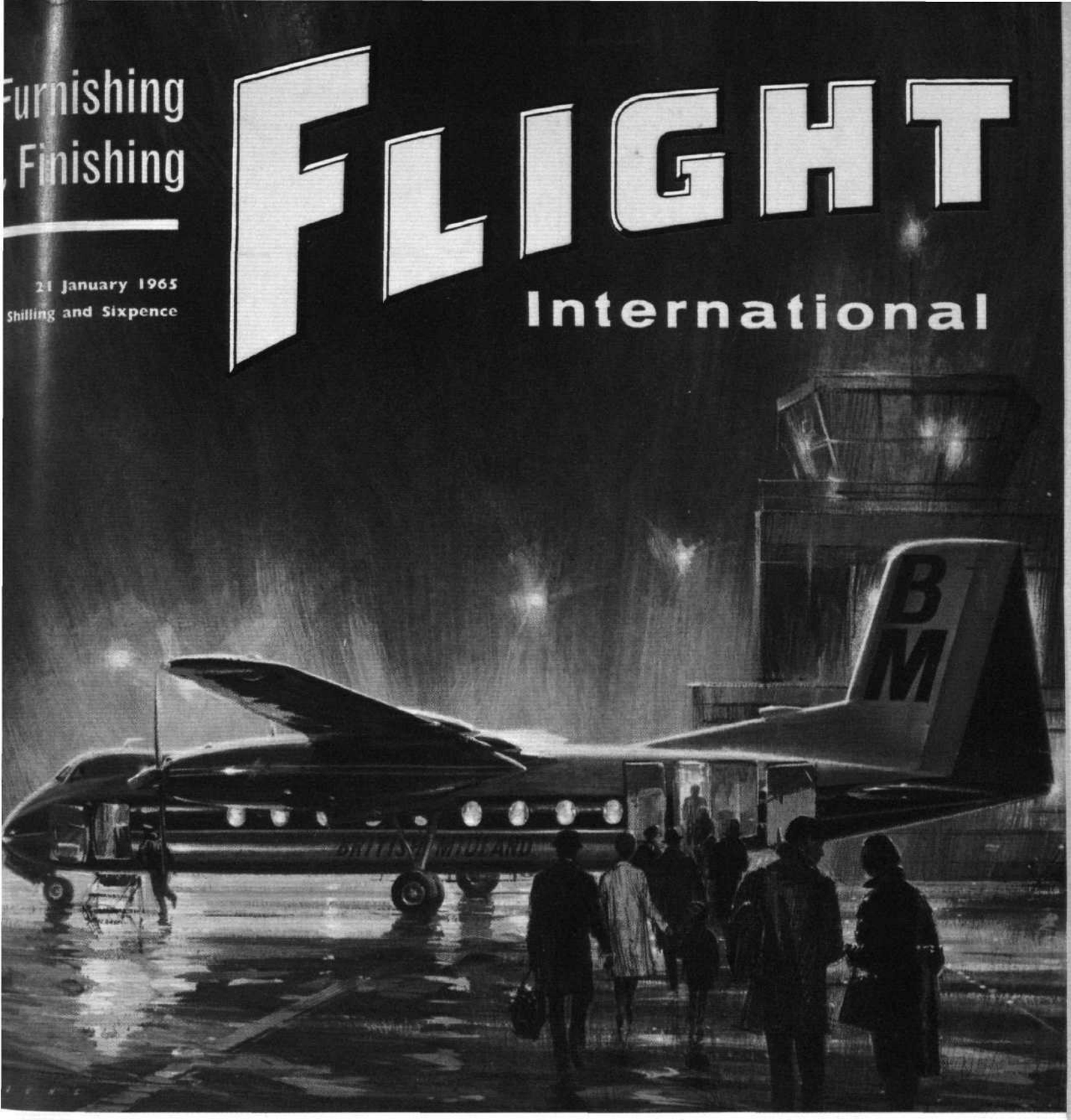

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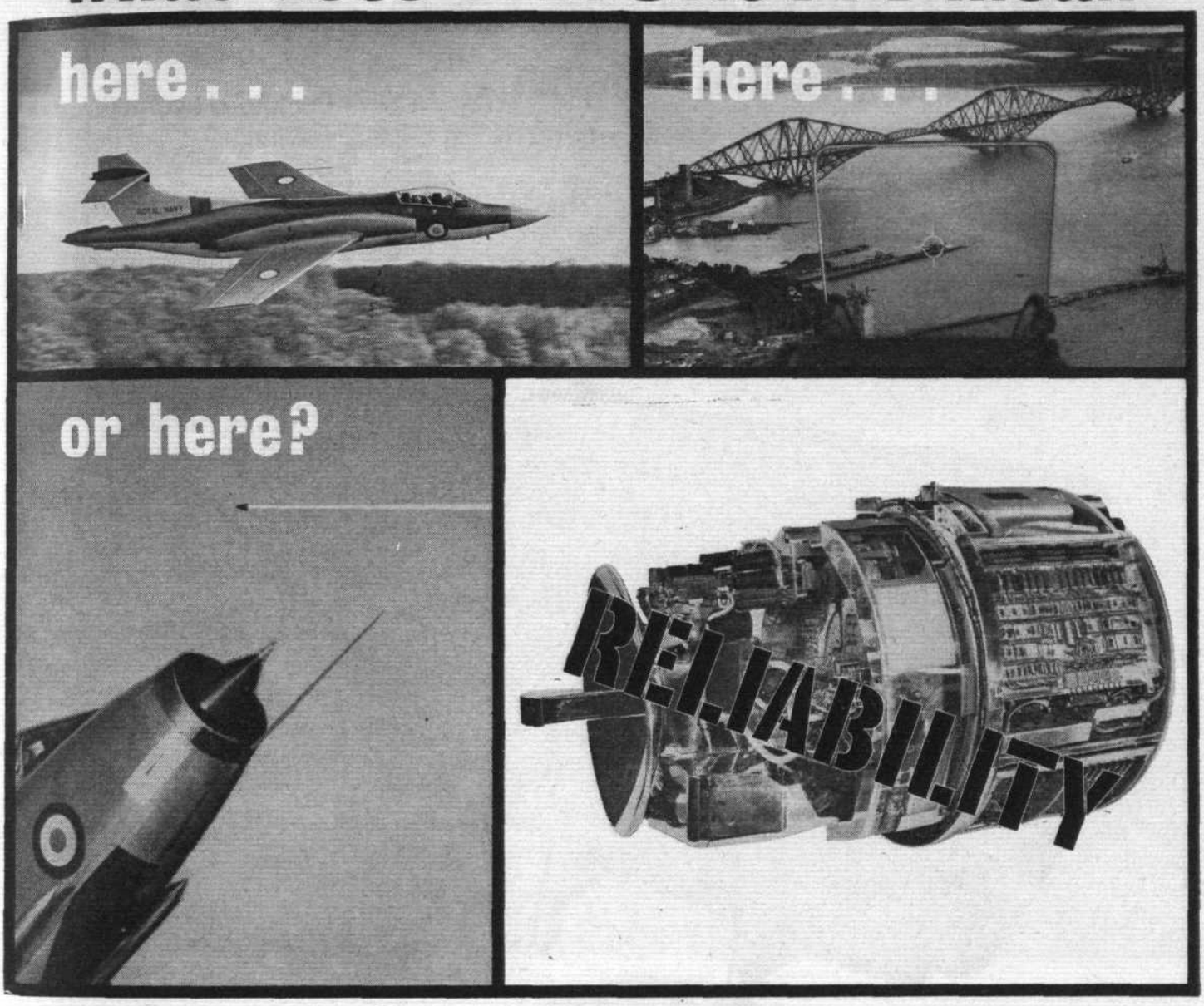
what does m.t.b.f. mean



. . . Ferranti reliability

Mean time between failures—m.t.b.f.—is a measure of the reliability of an equipment. Whether that equipment is a simple gyro gunsight or the interception radar of the Lightning, the weapon-aiming system of the Buccaneer or the terrain-following radar of the TSR2, it must be reliable to ensure high probabilities of mission success in the most arduous environments. Reliability of electronic equipment also permits high utilization of the aircraft, with increased effectiveness of the weapons system and more economic maintenance.

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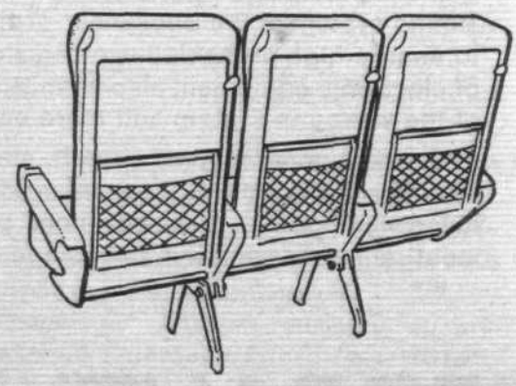

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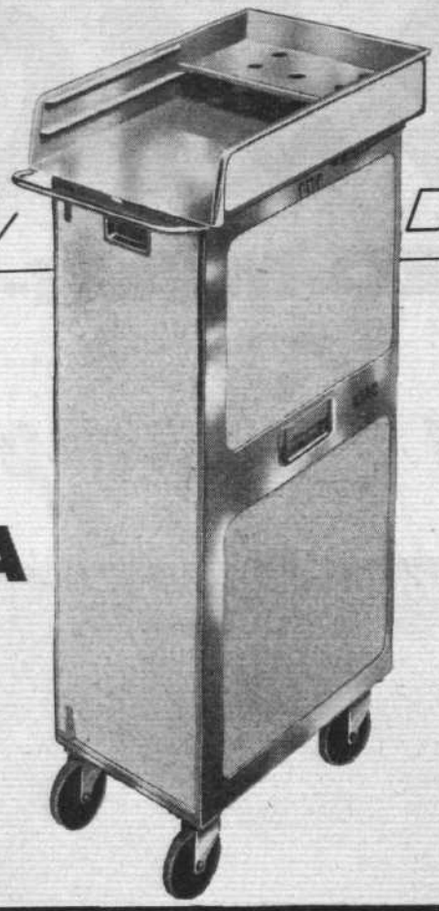

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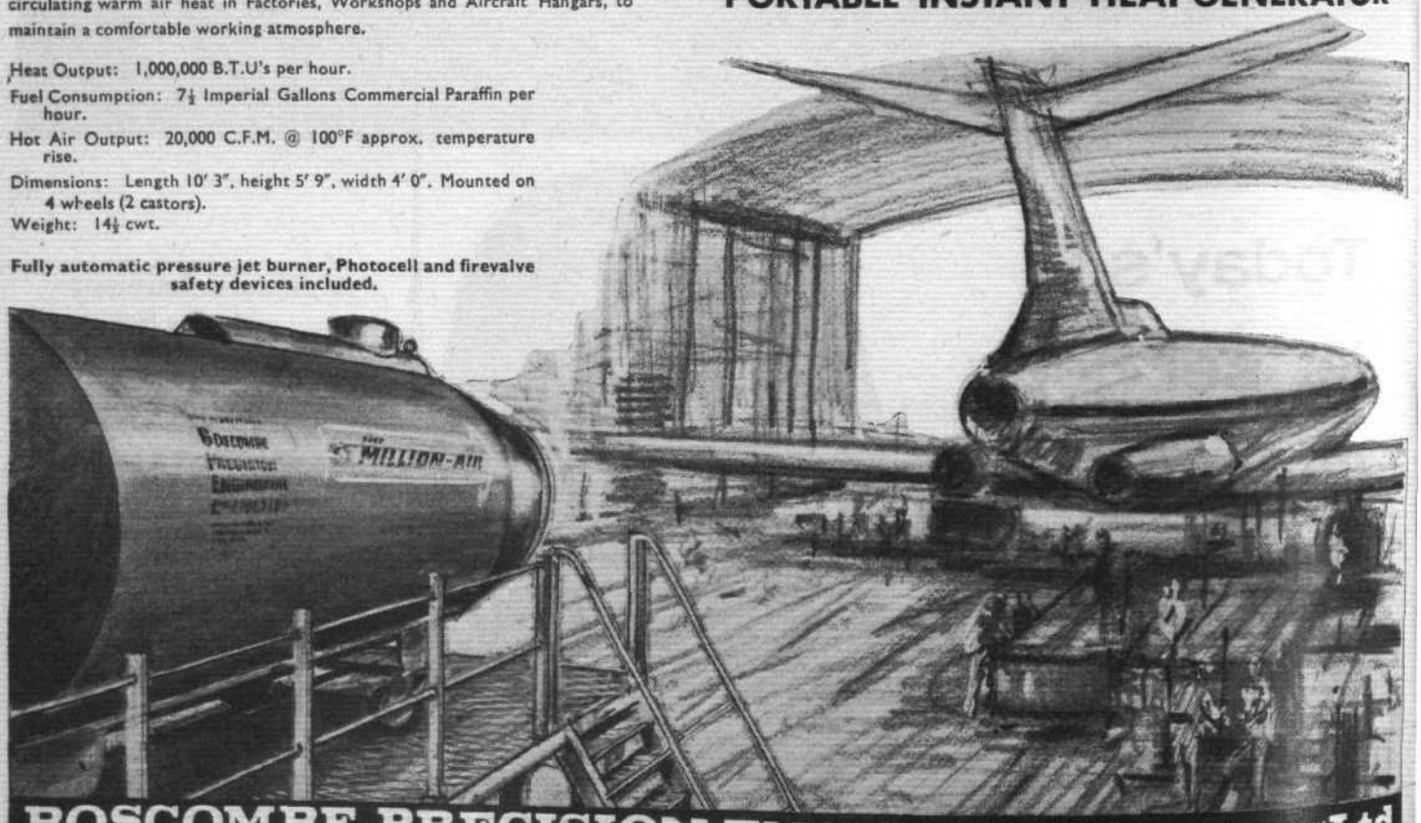

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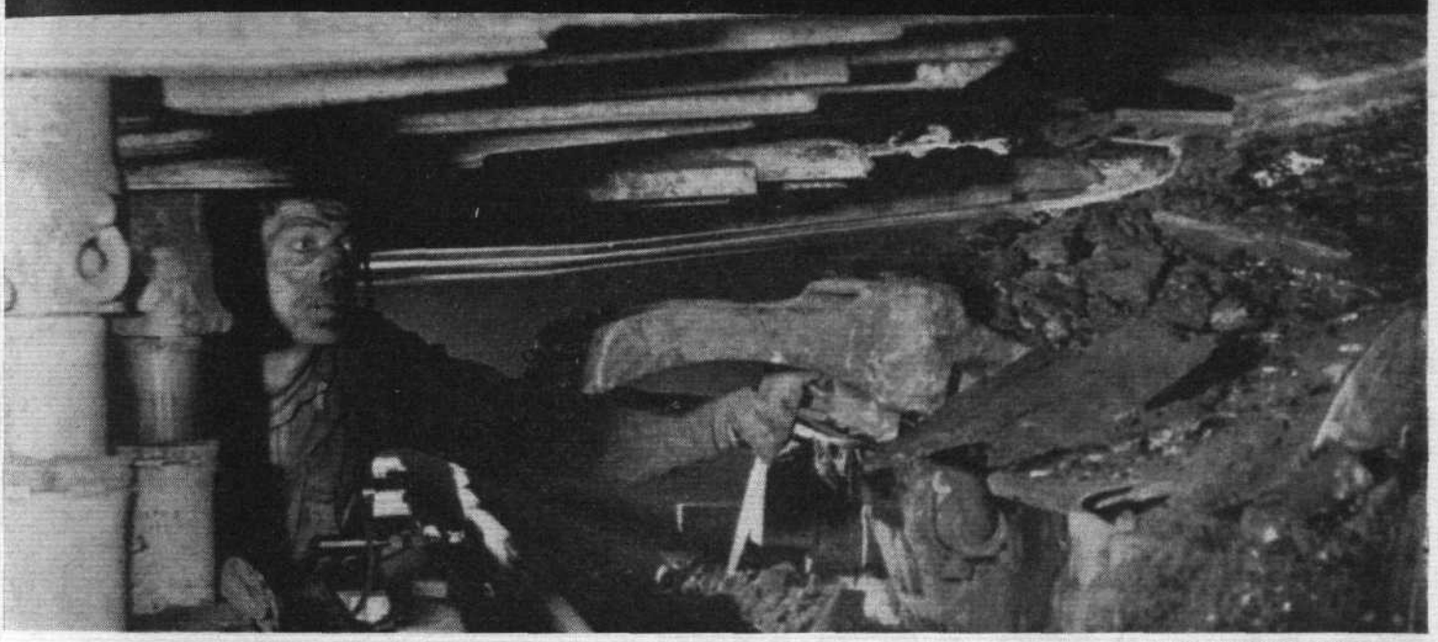
Parachute cutter at work



N.C.B. PHOTOGRAPH

Over-simplification perhaps, but coal, air and water are the basic ingredients from which nylon polymer is made.
We could make parachutes out of almost anything — including metal — if we had to, but generally speaking we prefer coal. The sight of 40,000 lbs. of payload supported beneath 1½ acres of white nylon is pleasing to the eye. It makes our customers happy, too, which is why we never seem to have enough nylon to satisfy our needs.

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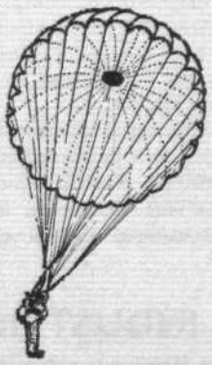

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Epsylon Industries Ltd. was responsible for the first British airborne digital recording system now in operational use and has designed and constructed the country's most up-to-date ground processor for military flight trials. This equipment is now complete and is in course of being commissioned in a Government establishment.

Part of the EFDAS equipment designed by Epsylon Industries Limited.

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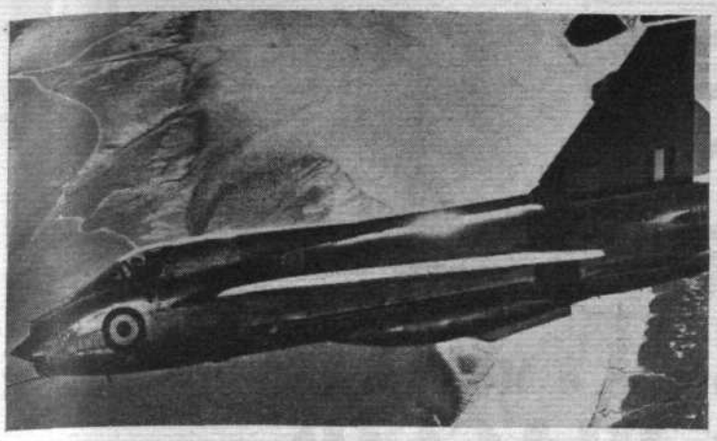

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P.166 B

Portofino

FLIGHT International

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THURSDAY 21 JANUARY 1965

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Assistant Editors
MARK LAMBERT BA
KENNETH OWEN BSc DCAe AFRAeS

Air Transport Editor
H. A. TAYLOR

Production Editor
ROY CASEY

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The One-way Escalator . . .

WHEN the last Minister of Aviation was reminded that he had estimated £400m for the cost of TSR.2, he replied with a defensive grin: "I can't remember, but whatever I said stands" (*Flight*, October 1, page 577). This particular Minister is no more to blame for the present industry crisis than the four other Ministers who at various times have been responsible for TSR.2. But such indifference to cost must have played its part.

Any business that neglects to control expenditure very soon finds itself moving on a one-way escalator towards trouble. And in aviation the trouble can be big, because the sums nowadays involved are vast and not easy to predict (though they are not as difficult as is often suggested). This means that as much care has to be given to the financial side as to the technical side. Growth of pounds sterling should be as great a cause for concern in design offices as growth of pounds avoirdupois.

The formula for what Mr McNamara calls cost-effectiveness can be spelt out. First, the objective has to be clearly defined. Whether the project is civil or military, this definition can only be done by the potential operator. An economist once decreed that governments should employ men to dig holes and fill them in again rather than to have them out of work; but it is usually better to employ them in doing something useful. Either way, the objective must be clearly stated, agreed and understood. And, where public money is involved, objectives that are defined and justified in public will be better objectives.

. . . And How to Get off It

Next, the feasibility studies and cost estimates should be carefully and realistically drawn up. Here the customer is very much in the hands of the contractors—of whom there must be at least two eager to get the job. The present Minister is known to have said that it may be better for the nation to have one major airframe manufacturer instead of two, and one major engine manufacturer instead of two. He will get the best value for money if there is always more than one contractor keen to put in a tender. Again, published cost estimates tend to be more realistic than secret ones; and they are likely to be even more realistic if the contractor has to share part of the risk with the taxpayer, and if he has to carry the penalties of escalation.

Lastly, when the costing is done resources can be allocated. Budgetary control, and the modern management techniques like PERT and CPM that give it precision, can obviously only begin with a budget. No company can be held to account for exceeding a budget which—as in the case of TSR.2—it has never been given. And just as objective-definition and cost-estimation should be open, so too should budgetary control. When control begins to run away the flashing of a warning light is the surest way to avoid disaster and to ensure smooth, stable progress towards the objective. How the British aircraft industry yearns for that.

These are the lessons which the present crisis teaches. Lord Plowden and his committee could usefully devote themselves to working out the detailed formulæ by which they could be applied.

WORLD NEWS

CRISIS WEEK

Concern over possible implications of the Government's current review of aviation projects was reflected in private meetings and public demonstrations last week. Industry leaders met the Minister of Aviation, Minister of Defence and the Prime Minister, while employees from British Aircraft Corporation, Hawker Siddeley Aviation and other companies staged mass meetings at their factories and a large-scale demonstration march in London. The week was one of widespread reaction to speculation that the TSR.2 programme, in particular, might be cancelled or curtailed.

No statement was issued following the Chequers dinner on Friday at which five industry leaders and Mr Roy Jenkins discussed the industry's future with the Prime Minister. It appears, however, that decisions on major projects such as TSR.2 may well be announced in Parliament prior to publication of the Defence White Paper on February 16.

The Society of British Aerospace Companies reacted to the Defence Ministry "wet-nurse" statement (made at a non-attributable Press briefing on January 8 and attributed to Mr Denis Healey, Minister of Defence, by the air correspondent of the *Daily Telegraph*, who had not attended the briefing, on January 11) by requesting and obtaining a meeting with Mr Healey on Wednesday, January 13.

Last Saturday, January 16, the SBAC announced: "Export forecast information received from the main British aircraft, aero-engine and guided-weapon companies indicates that the value of United Kingdom aero exports in 1965 will double the 1964 total. The industry's export total for 1964, available later this month, will be approximately £90m. Deliveries in 1965 against current export contracts are expected to push the 1965 total to a record figure of £180m.

"Among the aircraft types which will be delivered in 1965 are VC10s, BAC One-Elevens, Tridents, HS.748s, HS.125s, Heralds, Buccaneers, Westland helicopters and Bloodhound missiles. Engines and equipment in support of these aircraft, and engines and equipment for installation in foreign-built aircraft, will also contribute to the increase. In particular, the Rolls-Royce contribution will be very substantially larger than in 1964."

(Crisis-week Diary: page 121)

DOUGLAS DC-9 ROLLED OUT
Air Transport, pages 83, 85

ESRO's 1965 PROGRAMME DETAILED
Spaceflight, page 116

NORTHROP OFFERING SUPERSONIC NAVAL FIGHTER Defence, page 118

H. M. WOODHAMS

We regret to record the death last week of Mr H. M. Woodhams, CBE, FRAeS, MIProdE, who retired in August 1960 from his appointments as chairman and managing director of Sir W. G. Armstrong Whitworth Aircraft and director of Hawker Siddeley Aviation but remained on the board of AWA until its merger with the Gloster Aircraft Company in September 1961.

Mr Woodhams was one of the small band in at the birth of the British aviation industry. In 1908, when Cody was working at Farnborough and A. W. Roe was experimenting with his early machines, he was working with E. V. Hammond at Brooklands on the Hammond triplane.

At the outbreak of the First World War Mr Woodhams worked on Gnome Monosoupape rotary engines. He was then seconded to the Airco company, of which Geoffrey de Havilland was chief designer, as a specialist on these engines.

In 1923 Mr Woodhams joined Sir W. G. Armstrong Whitworth Aircraft, as chief inspector. By 1939 he had risen successively to works manager and then general manager.

Mr Woodhams

He became a director in 1941 and in 1950 was appointed managing director. In 1959 Mr Woodhams assumed the chairmanship of AWA also.

AWARD FOR VASI INVENTOR

A Government award of £1,000 has been made to Mr J. W. Sparke of RAE Farnborough in recognition of his invention of the visual approach-slope indicator, the aid now in use at some 100 international airports, and at 400 airfields in the United States alone Two years ago Mr Sparke and his collaborator, Mr E. S. Calvert, were presented with the American Laura Taylor-Barbour award for this work. Mr Sparke was the first man to construct a visual flight simulator at RAE, and sophisticated versions are now being built for the Blind Landing Experimental Unit at RAE Farnborough and for assisting work on the head-up display system at Farnborough.

Beginning its Task *of inquiry into the aircraft industry, the Plowden Committee was in session for the first time on Monday, January 11, at Shell-Mex House in London, where these "Flight" photographs were taken. The members (whose terms of reference were detailed on this page for December 17) are, l to r: Admiral of the Fleet Sir Caspar John; Mr Austen Albu, MP; Sir William Penney; Mr Norman Craig (head of secretariat); Lord Plowden (chairman); Mr Aubrey Jones, MP; Mr David H. Barran; Mr Frederick Hayday; Mr Christopher McMahon*

BEA's Sikorsky S-61N *G-ASNM alighted four times on the Thames at Battersea last Thursday, January 14. Captain J. A. Cameron was completing its trials programme for full ARB certification for amphibious operations*

C. F. JOY FOR HP BOARD

It was announced last weekend that Mr C. F. Joy, FRAes, chief designer of Handley Page Ltd, has been appointed a director of the company. Mr Joy, who started a steadily progressive career in the design and production spheres of the industry 38 years ago, joined Handley Page in 1944 as deputy chief draughtsman when the company was producing the last of its 6,176 Halifax bombers. Thereafter he held the posts of assistant chief designer and deputy chief designer during the vital gestation period of the Victor which, under Mr R. S. Stafford, technical director, was his particular responsibility. Mr Joy was appointed to his present position of chief designer in 1953.

Mr C. F. Joy

ALL CHANGE, PLEASE

Travellers who donated their small change in foreign coins brought increased benefit to the RAF Benevolent Fund in 1964—to a total of £2,117, compared with £1,563 in 1963. Since introduction of the scheme in 1955, £16,078 has been collected and exchanged for sterling.

Coins collected at ports in 1964 were of 46 different currencies, and the majority were received at airports. One airport contributed for the first time—Luton, from which £98 was received.

Totals from the various airports, air terminals and seaports were:—

	£	s	d
London Heathrow	730	15	7
London Gatwick	578	16	10
Ferryfield	307	13	2
Manchester	133	15	9
Luton	98	10	2
Glasgow (Renfrew and Prestwick)	49	3	11
Northolt	22	3	3
Southend	19	15	0
Newcastle-upon-Tyne ..	11	13	6
BOAC Terminal, Victoria ..	11	7	7
Folkestone	25	1	1
Dover	21	14	1
Newhaven		2	11
Miscellaneous..	106	16	1
	2,117	18	11

Also announced by the Benevolent Fund is a donation of £4,500 received from the SBAC as a result of the Farnborough Show last September.

FIRST JET COMMANDER

The Aero Commander Jet Commander has been granted a type C of A. This business jet is now in service, the first hand-over being to the Timken Roller Bearing Company, on January 11. The makers have also

SENSOR

Future of the Royal Aircraft Establishment is still in doubt. At present the Establishment's overall research programme is decided by Ministry of Aviation headquarters; one strong possibility for the future is that the RAE may be given more independence, writing its own programmes and taking on work for other Ministries —such as Mr Frank Cousins' new Ministry of Technology—as well as for the MoA.

Mr Henry Marking, who has been chief executive of BEA for nine months, appears to be very firmly established in the driving seat.

Claims by British independent airlines that they are losing holiday charter traffic to foreign airlines are easily made but are never substantiated. In fact, in the opinion of one large tour operator, fewer British holiday passengers will fly foreign this year than in 1964. The higher the number that do fly foreign the stronger are next year's British claims for ATLB licences, so that traffic that flies foreign actually furthers the British case.

Boeing Still Decline to announce details of their 200-seat-plus, long-haul 707-820. Development has reportedly not been as easy as with the DC-8, and it is said that c.g. problems may force relocation of the main undercarriage.

A Royal Malaysian Air Force order for about 30 Canadair CL-41G Tutor jet trainer/ground-attack aircraft is probably imminent. The Malaysian Government dislikes strings attached to a US offer of the competitive Cessna YAT-37D, and its requirements are too urgent to give the BAC 145 pressurized Jet Provost much of a chance. In the two-and-a-half years between project study and MoA development contract, BAC Luton has fallen behind pressurized competition, but is competing hard for an RAAF order for 75. First flight is due next year.

More and more European airlines are being granted US charter authority by the American CAB—Caledonian (DC-7Cs), Eagle (Britannias), Kar-Air of Finland (DC-6Bs) and Sudflug of Germany (DC-7Cs). Inclusive-tour holidays in Europe for Americans, and IT holidays in the USA for Europeans, could lead to a traffic explosion of unprecedented proportions on the Atlantic in 1967-1970 (see also page 86). At least one of these companies has its eye on hiring big jets.

Expect Hawker Siddeley to stage its come-back into the ACV field shortly, as a partial insurance against over-reliance on aircraft programmes. Both HS Aviation and HS Dynamics will probably be involved. Hawker Siddeley was early in and quickly out of the ACV field some years ago with a few months' discouraging experiment with the unsuccessful Folland GERM (ground-effect research machine). Top management now suspects that the Group's retirement from ACVs was premature.

WORLD NEWS . . .

announced that 62 firm orders have been received for the $595,000 six/eight-seater.

Four different makes of executive jet are now in service (HS.125, Lear Jet, Jetstar, and Jet Commander); two others under development (HFB 320 Hansa and Dassault Mystère 20) should be through their trials this year.

HISTORY IN SCOTLAND

The Glasgow Branch of the Royal Aeronautical Society is looking for exhibits recalling the history of aviation in Scotland. It is holding an exhibition—beginning in late September 1966 and lasting three or four weeks—to mark the centenary of the Society. The main hall of Glasgow Art Galleries and Museum will house the exhibition, and film shows and lectures will be given in rooms. Mr W. Newman Alcock, branch secretary, has asked that anyone willing to lend exhibits should communicate with him at 57 Dumbuck Crescent, Dumbarton.

Inter-city STOL

Preceding the appointment of an FAA task-force to study development of civil V/STOL for inter-urban transport (reported on page 90) was a demonstration at Dulles International Airport, Washington, by a US Army DHC Caribou, which made a series of take-offs and landings from the 55ft-long helicopter landing area

RHODESIAN RAeS

The Council of the Royal Aeronautical Society has agreed to the formation of a Rhodesia Division of the Society. The fact that Rhodesia thus breaks away from the Southern Africa Division is due to the efforts of the Salisbury Branch, which has been pressing for such a move for some time past.

Officers elected at a meeting earlier this month were Capt M. O'Donovan, AFRAes (operations manager, Central African Airways), president; Capt J. R. Orbell, AFRAes (chief pilot, CAA), vice-president; Mr S. H. Guy, ARAes, secretary; and Mr R. A. Springall, AFRAes, treasurer. By virtue of his position as president of the Rhodesia Division Capt O'Donovan also has a seat on the parent Council in London.

The Division, which has branches in Salisbury and Bulawayo, has a total membership of over 230, with members from as far afield as Tanganyika, Kenya, Aden and the Sudan.

press

ROBERT BLACKBURN

When a great national crisis looms—and threatened extinction of the aircraft industry is just that—the role of the Press is vital. Without the daily newspapers, magazines, TV and radio, the existence of the crisis would be unknown to the majority of citizens. And, with Parliament on holiday, there would be no democratic forum for discussion of the issues involved.

Last week Britain's Press rose to the occasion. The crisis was real, not created to fill front pages. One could quibble about odd inaccuracies or scare stories, but to do so would be trivial and short-sighted.

The *Daily Mail's* leader of January 13 was a milestone—the first time a popular newspaper has hammered at the unnecessary secrecy surrounding so much of British aviation: "In contrast with America and France the Aviation Ministry refuses to publish advance and progressive cost figures on its projects. This precludes any public machinery which could flash red lights at an early stage." The *Daily Telegraph's* leader on January 11 summarized the TSR.2 issue with insight: "On the face of it, cost analysis seems to argue almost unanswerably against TSR.2; its American competitor, the TFX, is far cheaper. But wait: wait till the trade unions concerned, the technologists, all who make aircraft and fly them, have had their say. Under conflicting pressures nothing appears simple—nor is it."

One of the most penetrating leaders appeared in the *Financial Times* of January 14 under the heading "The Realities of Power." I would recommend a study of the full text to anyone who can obtain a copy. Of calculated leaks, a subject rarely discussed by newspapers, it says: "This kite-flying has respectable antecedents, but as being practised now has two substantial weaknesses. First, it rallies conservative forces, who naturally oppose any change. Second, it causes confusion in Government Departments, many of which have little or no idea about what is being proposed . . . Leaks may soften opinion into accepting a policy decision already made: if there is no decision, they sow confusion only." How I wish I'd written that.

A lot has been printed about Mr Richard Worcester and his reported role as an adviser to the Government, but not until January 13 did it emerge that, according to *The Times* political correspondent, "It was officially denied yesterday that Mr Richard Worcester is advising the Government on aviation matters. Whitehall explained that Mr Worcester has never met Mr Wilson and had not been asked for advice, although he has been a close friend of Mr Wigg, the Paymaster General, for many years." The *Telegraph* reported "signs of irritation in Cabinet circles at the tendency to describe Mr Richard Worcester as an 'adviser' of the Government." Why then did it allow the misunderstanding to persist for so long? On January 14, on the BBC Home Service, Mr Worcester himself denied that he was an adviser to the Government.

The industry leaders invited to dine at Chequers last Friday must have been pleased to know that they were seeing only one Mr W.

No less an authority than Sir Denning Pearson wrote to *The Times* in denial of a statement by Mr Worcester that "Rolls-Royce calculate the Concorde cost to be £1,000m."

Another letter in *The Times*, from Mr Robin Ollington, deplored the appointment of an American firm of design consultants for the interior styling of the Concorde, ". . . surely we could have picked a team that would be capable of producing a scheme as good or indeed superior to anything that could be dreamed up in the lush offices of New York?" Point taken, Mr Ollington, especially if you are a British designer who finds industry slow to appreciate that there are good designers here in Britain; but in fairness to the American involved it should be recorded that he has been working with British aircraft designers for years and is practically a transatlantic commuter.

Hurrah for the *Plane Makers*, ATV's superb series of plays about the fictional Scott Furlong and Ryan aircraft companies, which went off the air for a rest period last week. Even the title has passed into the language, and newspapers refer daily to the planemakers. For the convincing detail of the *Plane Makers*, a very good mark to Mr Michael Jolley, the 31-year-old public relations executive, pilot and honorary PRO to the Tiger Club, who advised on the third series, and another to the producers, editors and writers who took his advice at every stage. My only criticism (from first-hand experience) is that really big men in the industry are not as bad-mannered as Wilder or Corbett: quite the reverse.

Finally, a headline in the *Bournemouth Echo* of January 14: 10,000 MARCH OVER TSR.2.

AIR TRANSPORT

NEW PROGRAMME FOR THE US SST?

AN entirely revised policy for the US supersonic transport programme is now expected. It is being sponsored by Senator Mike Monroney, chairman of the aviation sub-committee of the US Senate Commerce Committee. *Aviation Daily*, in its January 14 issue, said that the plan is designed to "push the SST project off its present dead centre" and that the proposals "will find much ready response in industry."

Main part of the plan is for four prototypes to be built entirely at Government expense—two of them to the Boeing and two to the Lockheed design. These would be tested for two full years in order to discover which of the designs is the better proposition.

Second most important part of the proposal is to bring both Douglas and North American—with its experience of the XB-70, now considered to be a more useful flying testbed for the SST than was originally thought—into the programme. They would be partners respectively (but not necessarily in this order) of the two primary airframe contractors, each with responsibility for about 25 per cent of each project.

On the powerplant development side, the Government might be expected to carry the greater part, but not the whole, of the costs incurred by Pratt & Whitney and General Electric, the two selected for SST work.

In the meantime the proposal is that the Federal Aviation Agency should remain as the co-ordinator and sponsor of the overall SST programme. When the best design has been selected as a result of exhaustive ground and air testing, the manufacturers of the successful aircraft would then be expected to risk capital on production, series testing and sales.

PAN AM'S PANAMAC

BECAUSE, unlike the advent of jets, the introduction of electronic booking and ticketing has done little for the passenger which was not already expected under the old systems, such devices tend to be taken for granted. Most big airlines are planning, or have installed, such systems, but so far none have been quite so vast, versatile, or world-wide as Pan American's Panamac.

Heart of Panamac is a pair of IBM7080 computers housed on the fourth floor of the 59-storey PanAm building in New York. The computers store information and take logical decisions on the booking status of any Pan American flight (cargo or passenger) and of any of the hotels in the airline's world-wide chain. Inquiries and information to and from the computers are fed automatically through various processing and transmission systems which, eventually, will be directly connected to more than 700 ticket-desk units.

The system first began operating in its definitive form towards the end of last year. As yet only part of the overseas network is operational. Junction for the European chain is to be London, through which all the Continental desks will be linked automatically *via* transatlantic cables to New York. *Flight* last week was able to watch the system in operation in the carrier's London sales office, after just over a month of trouble-free operation.

All that the passenger sees of Panamac when calling to make a booking is a typewriter-like device recessed into the counter; there is also a control board on to which a card is placed for the appropriate route or service. The desk clerk selects the keys for information on seat availability and the answer comes back within seconds.

First two DC-9s are seen here before the roll-out ceremony at the Douglas Long Beach plant on January 12. Initial flight is scheduled for early March. *(Story on page 85)*

AIR TRANSPORT...

British Eagle 1964

BRITISH EAGLE INTERNATIONAL AIRLINES published last week its financial and traffic results for 1964. An operating surplus of £853,700 was earned after writing off £300,000-£350,000 in losses on UK domestic trunk service development. A net profit of £101,500—representing about 2 per cent of the total assets (£4.9m) deployed—was left after allowing for depreciation and other charges.

This is the second private British airline to publish details of its annual results and the figures are probably the most useful so far made public—*pace* Air Holdings (British United Airways), whose consolidated results necessarily cover a much wider range of activities. At the risk of tedium for those who know, it should be said that *all* US airlines, as a matter of requirement, publish detailed traffic and financial results monthly, quarterly and yearly through the CAB and the Air Transport Association of America. But British Eagle's decision is a good continuation of the start made by Air Holdings on this side of the Atlantic.

Neither the traffic nor the financial figures for British Eagle give a detailed breakdown of losses and gains on different sectors of its operations. Losses on the domestic routes have been very heavy and it is unlikely that international scheduled services have shown much better than marginal profits. The profits have probably been made on inclusive-tour, charter and trooping operations. As a guide, the proportions of British Eagle's efforts in 1965 will be approximately 35-40 per cent on trooping, 20-25 per cent on charters, 10 per cent on inclusive tours and 30 per cent on scheduled services.

BRITISH EAGLE FINANCIAL RESULTS, 1964

	£
Revenue	8,588,000
Operating surplus	853,700
Estimated net profit	101,500
Assets deployed	4,900,000
Subscribed capital	1,000,000

STATISTICS, ALL SERVICES

	1964	Percentage change over 1963
Passengers carried	540,000	+254
Miles flown	9,250,387	+134
Seat-miles flown	1,082.4m	+300
Passenger-miles flown	801.6m	+280
Passenger load factor	74%	(76%)
Capacity ton-miles	134,706,000	+212
Load ton-miles	92,186,000	+204
Weight load factor	68%	(70%)
Staff (December 31)	1,766	+107

During the press conference at which these results (summarized in the two tables above) were announced, Mr Harold Bamberg, the airline's chairman and managing director, stressed many times the vital importance to British Eagle—and to the private airline industry in general—of an unequivocal statement by the Government on its policy for the nationalized and private sectors of this industry.

Plans for the purchase and introduction of six BAC One-Elevens on domestic and international services have been completed by British Eagle, but finalization must obviously depend on a statement of policy (for which, we might add, the British private airlines have been waiting, on and off, during most of the past 20 years). Pressed for his ideas about a satisfactory statement of policy from the Minister Mr Bamberg said, speaking off the cuff, that the first requirement was obviously an assurance of approval for competitive effort by the private airlines. It would be necessary for the Minister to support this by confirmation in the form of proposals for the implementation of such a policy. Primary needs would be for long-term licences—at least ten years—for scheduled services and inclusive tours so that there could be real prospects of development and stability. It would also be necessary for the Minister to spell out, once again, the spheres of corporation and independent influence. Full competitive freedom for the independents could, in any case, be real only if they had the rights to unlimited frequencies on domestic services.

Mr Bamberg made no bones about the fact that traffic on British Eagle's domestic services had so far been poor. The average passenger load factor on these services in 1964 had, he said, been 31 per cent, with (for the main trunks) London - Glasgow showing the best results and London - Edinburgh the worst. He considered that three daily services a week on the routes was the minimum frequency for potential profitability. He added that a domestic traffic-growth rate of 20-30 per cent a year more than justified parallel operations by a second carrier.

Flight, in its issue of December 3, 1964 (page 948), tabulated British Eagle's traffic results on domestic services between their start on November 1, 1963, and October 31, 1964. Passenger load factors were: London - Glasgow, 24 per cent; London - Belfast, 26 per cent; London - Edinburgh, 13 per cent; and London - Liverpool—operated by British Eagle (Liverpool), previously Starways—57 per cent. The average was 31 per cent.

Among British Eagle's plans is one for a new engineering base in No 2 maintenance area at London Heathrow. A site has been held for some time, but final plans await access and facility decisions by the Ministry of Aviation. Eagle has also asked to be allowed to build a passenger terminal on the airport's north side, but permission for this has so far been refused because the proposal does not fit in with the Ministry's plans for Heathrow. If refusal is maintained, a request for permission to build a terminal in the maintenance area will be made.

Group charters are to be started by Eagle this year over the North Atlantic (London/Manchester/Prestwick - New York) with Britannias, beginning at the end of May and continuing until September. If Eagle's appeal against the ATLB refusal of Bermuda and Caribbean inclusive-tour rights is successful, and if the decision is reached soon, a start on these operations might be made in September. Fleet in 1965 will consist of 12 Britannias (two of the present 14 are on lease from BOAC) and nine Viscounts. The two DC-4s will be sold.

Mr Alan S. Boyd has been redesignated by the White House as chairman of the US Civil Aeronautics Board for another year.

Syrian to Have Super Caravelles Two Super Caravelles are to be bought by Syrian Arab Airways.

Redifon is to supply Iran with new VHF and HF communications equipment for the airfields at Abadan and Shiraz. A similar contract for Mehrabad (Teheran) and Isfahan airports is now being completed.

Two More One-Elevens may be ordered by Mohawk Airlines, with an option on three. This was said at Weybridge last Friday by Mr Robert E. Peach, the airline's president. Mohawk now has five One-Elevens on order and two on option.

Heralds for Brazil's Sadia A contract has been signed by Sadia SA Transportes Aéreos, the Brazilian domestic airline, for five Handley Page Herald 200s. Two aircraft will be delivered immediately; the remaining three will follow when foreign exchange is allotted. Sadia has been operating Heralds already under a lease agreement.

In-flight Movies for Pan American The next airline to enter the passenger entertainment business will be Pan American. This spring the carrier will begin a $3.87m programme of fitting 72 of its aircraft with the Sony/United Data Control multi-channel visual-audio entertainment system similar to that already adopted by American Airlines. Pan Am expect the system to be using colour in about a year.

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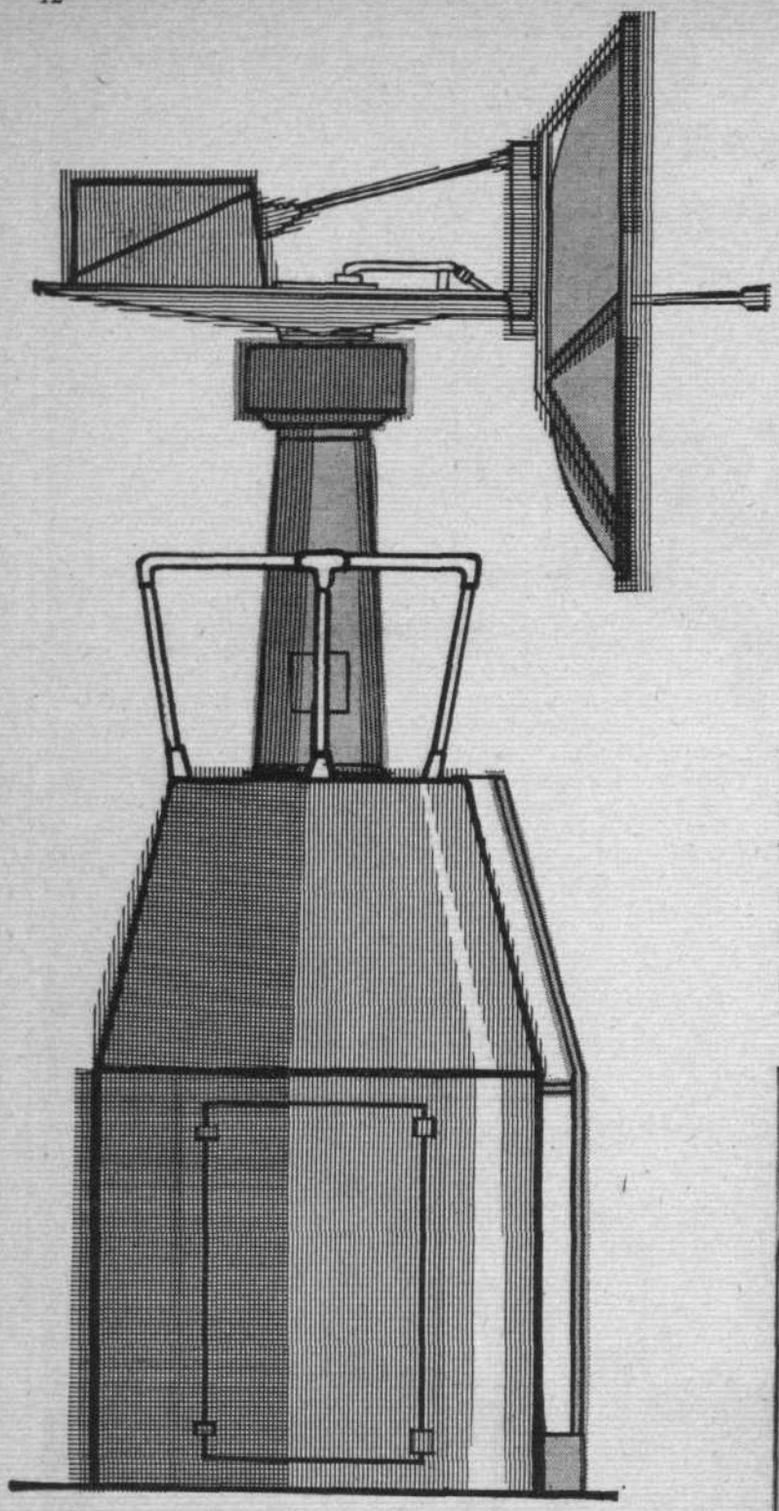

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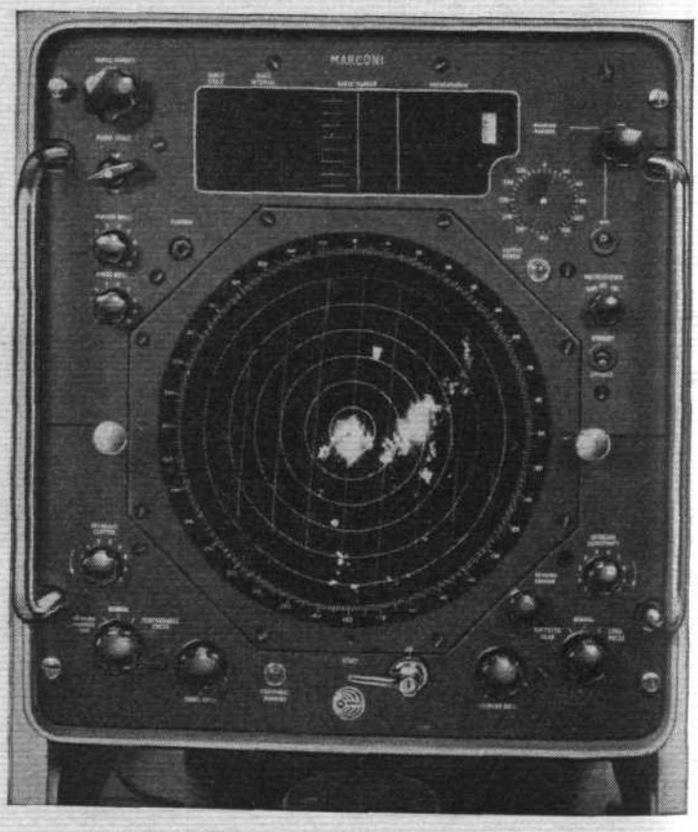
This low-priced meteorological radar is completely self-contained. The transmitter/receiver is housed in a specially designed aluminium tower. Installation, on any site, is simple and inexpensive.



Frequency range	9415-9475 Mc/s
Peak power output	70 kW nominal (60 kW minimum)
Aerial	6′ parabolic dish
Beam width	1.4°
Aerial rotation speed	13 r.p.m.
Displays	12″ PPI high brightness (incorporating electronic bearing indicators which preclude parallax errors)
Display ranges	12½, 25, 50, 100, 150, 200 n. miles

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AIR TRANSPORT . . .

DC-9 ROLLED OUT

ON January 12, just 20 months after the project was given the go-ahead, the first Douglas DC-9 rolled off the Santa Monica production line 2½ weeks ahead of schedule. Closely behind was the second aircraft on the line looking nearly complete. The very short incubation period, even by present-day standards, is the more remarkable bearing in mind the co-ordination that had to be organized by Douglas with and between the seven widely dispersed major cost-sharing subcontractors, each entirely responsible for the design and manufacture of contracted portions of the aircraft. The first flight of the DC-9 is still planned for early March but, the makers say, could be made late in February.

The roll-out of a new Douglas Commercial is always an event of great importance and this one was no exception. While the Long Beach Municipal Band played a stirring march the new short-hauler, the company's first since the DC-3 and resplendent in the house livery of white with red and blue cheat-lines, was towed from the assembly hall to the flight hangar. Mr John C. Brizendine, Aircraft Division deputy general manager DC-9, described salient features of the design to some 600 guests and world Press representatives. Inside the hangar stewardesses from each of the airlines which have together ordered or hold options on a total of at least 100 DC-9s descended from the aircraft on its self-contained boarding stairs. As each emerged, Mr Brizendine introduced hostesses from Air Canada, Bonanza, Delta, Hawaiian, KLM, Swissair and TWA.

Airframe details of the DC-9 revealed for the first time at the roll-out mainly concerned devices to ensure satisfactory stalling characteristics. This aspect of DC-9 development is obviously going to receive a lot of attention by Douglas and progress will be watched with great interest by airlines and airworthiness authorities. Apart from the recently announced increased tailplane area, the prototype is fitted with two underwing fences protruding beyond the leading edge and extending back to the beginning of the inward-sloping shroud of the double-slotted flaps. Called by Douglas "vortilons," the devices, appearing roughly in line with the tailplane tips, are intended to create turbulence and spoil lift to give positive pitch-downs at high incidence. The underwing position was probably chosen for minimum drag penalty.

Flying controls on the DC-9 are basically similar to those on the DC-8—in other words manually operated servo tabs for pitch and roll and hydraulically operated rudder with trim tab. The elevator, attached to the high-mounted variable-incidence tailplane, is in two independent halves and, in addition to the inboard cable-operated servo tabs, has geared tabs outboard to provide an added mechanical advantage over elevator loads. The ailerons have trim tabs in addition to the manual servo tabs.

The DC-9 flying trials programme is scheduled to take just over a year. The first deliveries to airlines and the type's commercial debut should be around the middle of next year.

Decision on the Boeing 737 is expected before the end of this month. The primary factor in this decision, says *Interavia*, is the attitude of United Air Lines, the most important prospective customer.

Braniff Airways' BAC One-Elevens are to be operated in a standard layout for all-coach-class operations with five-abreast seating and 36in pitch.

Mr J. P. Delanney has been appointed general manager for UTA in the USA. Mr Delanney has been with UTA and its predecessor since 1958.

Mr Max Edy, an ATC specialist with the Australian Department of Civil Aviation, has been appointed president of the Air Navigation Commission of ICAO.

London Heathrow handled 9,461,000 passengers and 187,500 aircraft movements in 1964. The passenger figure, which is provisional, shows a 15.6 per cent increase on the total for 1963.

Two More CL-44s have, according to *Aviation Daily*, been ordered by the Flying Tiger Line for immediate delivery. This increases FTL's CL-44 fleet to 12. Two more of the 39 aircraft built by Canadair still remain to be sold (*Flight*, December 31, page 1107).

Mr J. R. Sidebotham, formerly chief planning engineer of British United Airways, has been appointed assistant to the managing director, Mr F. A. Laker. The previous holder of this position, Mr A. Todd, is now cabin staff manager.

Mr Christopher Spence, for seven years charter manager for BOAC in the USA, has joined British Eagle in a similar capacity to look after North America. Mr A. Trop, previously Eagle representative for the Continent, is now manager, general services, N. America.

Japan Air Lines Flights on Europe - Tokyo Routes will be increased in 1965 from four to seven per week. Four of these will be over the Polar route and three via the Middle and Far East. JAL will take over its 11th DC-8 this month and its first DC-8F shortly afterwards.

Second Fokker F-27 for East-West Airlines of Tamworth, New South Wales, Australia, was handed over at Schiphol Airport earlier this month. A third F-27 has been ordered by East-West ("Flight," January 14, page 46)

The first Hawker Siddeley Argosy 222 destined for BEA (actually the second series 220 to fly) takes off from a rain-soaked Bitteswell airfield. BEA has five 222s on order for delivery in the near future. Next week's issue of "Flight" will contain a number of special articles which examine the Argosy's past performance and future prospects

AIR TRANSPORT...

AERO-NORD REPLACES NORDAIR

A NEW charter and IT operator called Aero-Nord has been formed in Denmark (see last week's issue, page 46). Three DC-7Bs have been bought from American Airlines for £400,000, and these will each be converted to a 104-passenger configuration. They will be delivered, fully overhauled, in March and the new company expects to start operations on April 1.

Because of the serious hangar shortage at Kastrup the company has been forced to build its own hangar on the southern side of the field. It is all-steel, of British manufacture, and will be ready by about May 1. Major overhauls will, however, be done by American Airlines, which is also responsible for the conversion of the aircrews.

The management and a large number of the staff of Aero-Nord were formerly with Nordair—the Danish charter company which ceased operations a few months ago after being taken over by SAS. The chairman is Mr Erik Ostbirk, formerly managing director of Nordair and the founder of that company. Managing directors are Mr Alex Lauesen (traffic and sales) and Mr Hugo Pedersen (economics). Chief pilot is Mr A. A. Schmeltz and technical and sales managers are, respectively, Mr K. Togeby and Mr Erland Hansen.

BEWARE THE IMPORTED AIRCRAFT

A WARNING has been issued by the Air Registration Board addressed to British operators contemplating the purchase of secondhand aircraft from abroad. In future before a C of A is issued the Board will require more evidence that repair and maintenance work has been conducted in accordance with BCAR standards. The ARB notice speaks of some difficulty in the past in establishing compliance with requirements in respect of an aircraft's previous service. Examples are quoted:—

Repairs have been embodied without supporting records to establish compliance with approved schemes or manuals. Modifications have been incorporated without adequate records to indicate the source of approval and the organization responsible for installation. Doubt has often arisen as to the extent of compliance with ARB maintenance requirements, particularly those relating to major inspections or overhaul work which ensure the structural integrity of the aircraft (such as de-sealing of integral fuel tanks), and the relation of component and accessory overhaul periods to those approved by the Board.

The ARB warns potential purchasers that before negotiating for secondhand aircraft to be imported into Britain, the Board's new requirements should be borne in mind. They are that:—

(i) Repairs and modifications comply with corresponding British Civil Airworthiness Requirements and that, if this cannot be established, satisfactory supporting records are available from an acceptable source such as the original manufacturer, other airworthiness authority, or a suitably approved design organization in this country.

(ii) Major inspections and overhauls have been carried out and all appropriate airworthiness directives complied with at, or within, those periods approved by the Board. When determining the period at which any requirement of the Board's maintenance schedule is due, the time at which the requirement was last done must be used as the basis of assessment.

CAB GREEN LIGHT TO INCLUSIVE TOURS

LAST week the Civil Aeronautics Board proposed its intention to grant all US supplemental carriers blanket authority to file inclusive-tour proposals for trips within America. This is the first time that the CAB has anywhere approved this kind of service which was pioneered in Europe. Once again the leading domestic trunk-line carriers will undoubtedly view the action as a further CAB threat to their livelihood following, as it does, the recent proposal to restrict blocked-space-rate airfreighting to the all-cargo carriers only.

Although the Board has stated the action should not be regarded as a pre-judgment of the soon-to-be-resolved North Atlantic IT question, European airline opinion believes a large-scale two-way overseas network of American IT services cannot be far off. Practically every country in Europe has an airline with transatlantic IT plans up its sleeve. In Britain Caledonian's proposal, approved by the ATLB, is past the public hearing stage of the appeal brought by BOAC, and should be coming before the Minister of Aviation any time now for final judgment.

Briefly, details of the CAB ruling on the domestic IT proposal are that the tour should be for at least ten days, involving three different overnight stops and the total price must not be less than 120 per cent of the lowest applicable normal fare. Brochures describing the tours must be filed with the CAB prior to the sale of any tickets and at least 60 days prior to departure; organizers must also file a surety bond with the board. Finally, the carrier may not act as tour organizer.

The CAB gives two main reasons for the decision to indulge in a little "controlled experiment" with inclusive tours. The success of this kind of service within Europe is viewed as a pointer to a similar *new* source of traffic within America. Supplemental carriers, rather than the scheduled combination carriers, were chosen for the experiment because of their present relatively underprivileged situation.

When most other sections of the industry are settling into profitable and stable operation the supplementals are facing difficulties and uncertainty. The supplementals were recently told by the Defense Department that a carrier would be required to show that at least 30 per cent of its revenue could come from civilian operations by 1966 for consideration for military contracts. Many carriers at the moment exist almost wholly on military contracts.

The "Departure Charge"—a Deception?

SENSOR hit the target in his new column (*Flight*, January 7, page 3) by drawing attention to the iniquitous charge of 7s 6d which is collected by airlines operating international services from the UK to destinations other than the United States. Let us look more closely at the facts from the passenger's point of view; the airlines' view of the nature, amount and variety of charges which have to be paid at UK aerodromes generally would be a subject for separate treatment.

Before November 1 last year the Ministry of Aviation levied 7s 6d on each international passenger. This was called the Passenger (or Airport) Service Charge and was collected by the carrier *on behalf of* the Ministry at its aerodromes and elsewhere.

Statutory Instrument No 1071 of 1964, laid before Parliament on July 16 last year, raised Navigation Services Charges upon the operator which became payable on and after November 1, 1964, at Heathrow, Gatwick, Stansted, Prestwick, Dyce, Aldergrove, Hurn, Rhoose, Turnhouse, Renfrew, Ringway, Elmdon and Speke. These regulations provide for a standard charge of 3s per 1,000lb of maximum authorized gross weight for each landing within the notified hours of watch. *Landings* outside the notified hours are surcharged by 75 per cent (double for helicopters) or the "additional cost incurred by the Minister," whichever is greater. *Take-offs* outside the notified hours are also surcharged at the same rate if the landing is made during notified hours or made more than 1hr prior to the take-off. If the Great Circle stage length is less than 115 miles that part of the charges which is based on 3s per 1,000lb is halved, but no alteration is made to the "additional cost" provisions. The Minister has power to dispense wholly or in part with any of these charges if he is satisfied that it is proper to do so.

The Navigation Services Charges have to be borne by the operators *in addition to* the standard landing charges, which start off at a basic rate of 6s for 1,000lb for small aircraft and which have variations in the rate for aircraft over 26,000lb and 200,000lb, and also many complex rebates, surcharges and exemptions for the landing charges, which make direct comparisons difficult. But it is clear that the operator from November 1 has faced additional operating costs at the listed aerodromes. There are charges at other aerodromes, too, broadly in line with the Ministry charges. The original date for the new charges was April 1, 1964, and it was only vigorous opposition from the airlines that led to its postponement to November 1. To their credit, IATA members made the strongest possible representations on the subject—all to no avail; the Ministry was paving the way for air traffic control to pay for itself after the loss of revenue from ordinary landing fees which will occur later this year when the Group 1 international airports are handed over to the new British Airports Authority.

Calculable Income

Most of the aerodromes involved maintain a comprehensive service of "notified hours" for scheduled aircraft—hence most of the Navigation Services Charges are payable on each landing and will produce a result which is not too difficult to calculate for (say) a year ahead for specific scheduled routes and aircraft. For UK-based operators this may very well affect all or a large part of their operations. For foreign airlines it is obviously a lesser element in their overall costs. Hence the UK carriers had little trouble in using the Navigation Services Charges to persuade the Air Transport Licensing Board to raise domestic fares—despite protests from Citizen Lucking, who seems to be the only regularly visible champion of air passengers in the UK.

It is important to notice that the Navigation Services Charges to the operator are really extra *landing* charges based solely on the weight of the aircraft. Additional charges for take-offs only arise outside the notified hours. Nothing is geared to the number of passengers or their origins and destinations or nationalities. IATA members, however, devised a brilliant scheme which was accepted by members of Traffic Conference No 2 in a mail vote on Resolution 295b. The essence of this is that, with the exception of transit passengers with confirmed onward reservations whose stop-over does not exceed 24hr, and passengers travelling at a discount of 76 per cent or more, all international passengers departing from the UK are charged 7s 6d. The advantage of this scheme is that, by an amazing coincidence, the surcharge is identical in amount to the previous Ministry Passenger Service Charge! The Resolution is only temporary, because on April 1, 1965, new and increased fares operate to take account of higher UK and other costs.

Despite the binding nature of the IATA resolution, its application does not seem to be universal. BUA, for example, did not want the surcharge to apply to their short ferry routes and obtained the necessary Ministry permission.

Lesser mortals might never have guessed that the precise effect on so many different airlines, whose operations are all affected in varying degrees by the new Ministry charges, could all be adequately compensated by exactly the same surcharge. So the effect was that On October 31 there was a last collection of the 7s 6d Passenger Service Charge for the Ministry of Aviation, and on the next day there was the first collection of the 7s 6d UK Departure Charge for the benefit of the airlines. No one but a quibbling idiot would notice the difference in wording on the receipt for 7s 6d and thus, with a great fanfare of trumpets, the airlines would be able to announce the discontinuation of the 7s 6d at the end of March 1965.

The CAB Refused

No one, that is, but the CAB—that well-known guardian of the public interest—who refused to allow the 7s 6d surcharge because, as their order E-21088 (adopted with one dissent on July 21, 1964) says, ". . . we find no basis, under sound rate-making principles, for singling out a particular group of passengers to bear the entire burden of this new charge to be imposed on the carriers. Moreover, the significance of the impact of the Technical [*sic*] Services Charge on the carrier's operations can only be evaluated by the degree to which it is reflected in the unit costs of operations. In this connection, no data are available which would show the economic necessity for any increase in fares, either the departure charge proposed, or otherwise, to off-set the increased cost to the carriers." The result is that passengers flying to the USA cannot (or *should not*) be charged the 7s 6d. If any other government has protested they have been remarkably silent about it. If there was to be any logic in the surcharge then it might well have been justified for passengers *landing* here, but certainly not for those departing.

The situation is further complicated by charges at municipal and other aerodromes. For example, an international passenger at Manchester, Liverpool or Birmingham may end up paying a total of 15s above the price of his ticket, while one at Southend pays nothing extra. Infants and airline staff at London also pay nothing extra, because their discount exceeds 76 per cent!

The present situation is therefore that, with the exception of the CAB, the IATA surcharge of 7s 6d appears to be approved by the relevant governments. But that is not the end of the matter. The airlines still have the task of imposing the surcharge by contract on their helpless passengers. It is still English law that contractual conditions, in order to be effective, must be drawn to the attention of the passenger at the time when he makes his contract of carriage. It is extremely doubtful whether any of the airlines involved have taken sufficient contractual steps for the 7s 6d surcharge to be enforceable against the passenger who hears of it usually for the first time when he checks-in *after* obtaining his ticket at a published fare and *after* having obtained a reservation and *after* presenting himself at the correct time and place in a fit state to be carried.

A bulwark through the ages, English Common law says it is too late to impose extra charges when once the contract is complete; and it only remains for the carrier to fulfil his part of the bargain by carrying the passenger to the agreed destination. Of course, junior airline officials have no power to depart from their instructions and may even have to make good shortages of 7s 6d out of their own pockets if they fail to extract the money from passengers. Hence the net result is that the passenger, in practice, is unlikely to get on the aircraft unless he surrenders 7s 6d. The most he can do is to pay under protest and claim a refund. It will be a rare bird who can risk going to court over 7s 6d, and airlines who resist must be well aware of this.

What contractual steps do the airlines take to draw the 7s 6d to the passenger's attention at the right time? Virtually none:—

(a) The IATA Conditions of Contract on the ticket do not even contain a warning that charges may change without notice.

Continued overleaf

AIR TRANSPORT...

(b) The ticket does attempt to incorporate "General Conditions of Carriage" by reference and, if the passenger succeeds in obtaining a copy, he will in most cases find therein a clause saying "Carrier's rules, regulations and conditions of carriage are subject to change without notice." It will be a nice question for the courts as to whether this well-hidden clause offers the carriers any consolation. The burden of proof is on the carrier to demonstrate that this clause was drawn to the passenger's attention in good time.

(c) Airline timetables and fares publicity sheets often contain no warning. A random sampling of current literature shows that BOAC, BUA, Lufthansa and Qantas make no mention of the Departure Charge (but Qantas do say that fares are "subject to change without notice") and that BEA, Sabena, PAA give some details of the Departure Charge (PAA is most detailed). Even the airlines which mention the charge give no hint that it is an *airline* surcharge and they separate it quite clearly from their lists of fares. In any case, many passengers never see this literature and it is doubtful whether any of it is really part of the conditions of contract.

(d) The *ABC World Airways Guide* still shows the UK Departure Charge under the heading of "Local Taxes," which implies a charge imposed by and for the benefit of a local government—which it most certainly is not.

This article is in no sense a justification of the scale of UK airport and air navigation charges which appear to be high by anyone's standards. It is concerned with points of principle for the airlines in their contractual relationships with the travelling public. Only small charges are involved for each passenger, but the year's end total may be considerable.

The discussion suggests the following conclusions:—

1. Most passengers who have travelled internationally from UK prior to November 1, 1964, are unlikely to realize that the purpose and beneficiary of the 7s 6d departure charge has changed and is no longer the Ministry of Aviation.
2. Not one airline (at the time of writing) advises passengers that the 7s 6d is a surcharge for the benefit of the air carrier.
3. IATA members, by charging an amount identical to the previous Ministry charge (without proper economic justification in the eyes of the CAB) have taken advantage of this situation.
4. Apart from the CAB, there is no visible official consideration of the overall public interest and the helpless position of the passenger in particular.
5. The acts and publications of the airlines tend to conceal the truth from ordinary passengers.
6. The Ministry of Aviation has connived at the overall pattern of deception and thereby displays a disregard for the travelling public.
7. In many cases the 7s 6d surcharge is legally unenforceable against a passenger who meets it for the first time on check-in.

The airlines, IATA and the Ministry should answer these allegations and, if they find them well-founded, show that they are capable of acting in the interests of the travelling public by suspending the operation of Resolution 295b. At the moment, any IATA airline which feels sufficiently moved by these arguments to wish to suspend the practice or to refund the 7s 6d on request is presumably in breach of IATA obligations and liable to a fine. There is no similar inhibition on the non-IATA members such as Aerolineas Argentinas and Icelandic, although officially they would presumably incur the displeasure of their own governments if they failed to collect a surcharge which had been agreed with the UK. If BUA can dispense with the surcharge in certain cases, then there can be no serious obstacle to an extension of the practice which would be welcome not only to the public but also to the airline and agents' staff who have the task of making collections. H. CITIZEN

MORE INERTIAL EQUIPMENT FOR PANAM

LAST summer we reported (page 171, July 30) Pan American's decision to adopt inertial navigation for all its 48 Boeing 707s then operating and for seven more on order. The system chosen was the new Sperry New York SGN-10 and the value of the order was $12m.

Now comes news of a repeat order, worth just under $1million, for an additional ten systems for use on five newly purchased 707-321Bs. Installation of the equipment concerned in both orders is to start this summer and the whole 707 fleet is to be equipped by June 1966.

TRIDENT 1E TRIALS PROGRESS

FLIGHT testing of the Hawker Siddeley Trident 1E, begun on November 2 last, has already shown the aircraft to be free from major problems and confirmed most performance and handling estimates. The first of this longer-range bigger-lift and more powerful export version of the Trident (ultimately destined for Kuwait Airways) completed 55 trouble-free hours flying in its first full month of trials; these included a tentative exploration into all aspects of the full trials programme. There seems every likelihood that the certification and delivery programme will go through on time.

During the first flight, Hawker Siddeley say, it was evident that the new wing design was superior in lift and drag characteristics and in low-speed handling, and there were no difficult stall problems. The satisfactory results of the first handling flights and the excellent serviceability have enabled the preliminary tests and measurements to be completed quickly. At the high-speed end of the flight speed-range, the Trident 1E has been flown to well beyond its maximum design speed, and has reached Mach 0.975 (650 m.p.h. TAS at 35,000ft—only some 10 m.p.h. less than the speed of sound); flutter and buffet tests were completed satisfactorily at this speed. At high speed the aircraft is said to have even better handling characteristics than the Trident 1.

At low speed the stalling characteristics followed very closely the results obtained with the temporary slat fitted experimentally to a Trident 1. The tests with this fixed slat, carried out during 1963, enabled production of the 1E wing, of bigger span and area, less sweep and with a movable slat, to be put in hand with confidence.

With the slat open, the 1E is reported to stall nicely with a positive nose drop and wings level. Tests with tufts have shown a small area of disturbed airflow at the junction of the inner and outer slats; smoothing the discontinuity is expected to increase further the already higher C_{Lmax} of this latest Trident. On the approach the low-speed handling is understood to be most satisfactory, with the speed-stability in particular showing an improvement on the Trident 1. The clean-wing characteristics also show all-round improvements compared with the earlier aircraft.

Gross-weight take-offs at 132,000lb, with engine-cuts at the critical point, have been measured, and tail-down take-offs with engine-cuts and with different flap settings have demonstrated the total absence of ground stall. Take-offs and landings over the full c.g. range have been performed successfully and take-off and initial climb measurements to finalize flap settings have been completed.

Measurements of cruise performance show that the figures for overall drag and fuel consumption are in accordance with estimates. The Rolls-Royce engines at present installed are pre-production examples of the Spey 25 series. Hawker Siddeley say: "So far engine behaviour has been exemplary and preliminary measurements indicate that the installed performance as regards power and consumption are as predicted."

FRONT-SEAT PASSENGER RISK

WITH the increasing use of light aircraft for general charter work, where passengers are frequently seated next to the pilot, the latest Ministry of Aviation pink *Civil Aviation Information Circular* warns of the dangers in this arrangement. Instances have been reported, the circular states, where passengers sitting in the right-hand seat have taken hold of the control column during flight in order, for instance, to help them to turn round to talk to the passengers in the rear seats. Such action could obviously lead to a difficult situation if it occurred at a critical time in the flight.

The circular suggests that when the second pilot's seat is to be occupied by a passenger, pilots of such aircraft should consider removing the dual column. Where this is not practicable, pilots should ensure that the passenger concerned is clearly briefed not to touch the controls.

"It is frequently said within Delta that the key to success rests on intelligent management by executives who know flying and maintenance and insist on the best service possible . . ."

DIXIE'S DELTA

DELTA AIR LINES, one of the leaders in size among America's second-division domestic trunk route carriers, has traditionally been one of the first with new aircraft and ideas. The big expansion from a position as a mid-west north-south carrier began in 1961 with the CAB award of transcontinental routes. With headquarters in Atlanta, Georgia, Delta routes now connect most points in the mid-west and extend to New York, Los Angeles and San Francisco. The carrier also operates internationally—to Puerto Rico, Venezuela and Jamaica.

Even before its period of major growth, Delta was the first airline to put DC-8s and Convair 880s into service. In 1963 the airline was again the first to order the new Douglas DC-9 short-hauler to replace a large fleet of Convair 440s. Pioneering for Delta has not been fruitless. In 1963, a difficult year for most carriers, Delta earned nearly $14m on revenues of $200m. Sixty-two consecutive cash dividends have been paid on stock, plus a two for one split last year. The key to success? It is frequently said within the airline that the answer rests on intelligent management by executives who know flying and maintenance and insist on the best service possible. In line with this progressive thinking is Delta's approach to the problem of maintenance.

A maintenance system which permits major overhauls of aircraft on a two-shift, five-day-per-week basis is the way Delta ensures the smooth operation of its 28-aircraft jet fleet. Working on the block maintenance principle the system has operated now for seven years and developed through the change from piston to jet-powered aircraft.

The big event in any transport aircraft's life is the major overhaul. On a DC-8 or Convair 880 this is due every 16,000hr. At Delta they divide the work into eight parts. The aircraft therefore comes into the hangar every 2,000hr for a general check-over, but, in particular, for a major investigation into a particular area of structure or group of systems. In this way no aircraft is ever on maintenance for more than five days at a time. Years ago, under the old system, 20-30 days was not an unusually long period for a major overhaul.

A few specific advantages Delta gains by the staggered maintenance system are these: Full-scale work in the maintenance base need only be on five days per week so that all but a few engineers have a full two-day weekend; night working is also unnecessary. Workload is much more evenly spread and peak busy and slack periods are avoided. A maximum number of aircraft is available for heavy weekend traffic. The effect of unexpected malfunctions, requiring two or three days in the hangar, are less critical to the scheduling pattern; evening and weekend overtime work is an additional buffer for coping with emergencies. Lastly—but important to a progressive airline—the system permits a more thorough running watch on aircraft performance and operating standards.

Maintenance-base work is analysed each week from information sorted and processed by computers. The results of this work are primarily used for tracing the cause of delays. Though workshop engineers are traditionally suspicious of time and motion studies of this sort, Delta mechanics have accepted the study as a necessary process in the overall maintenance programme. Delta mechanics are the only group in the trunk-line industry not to be organized by a union. The Delta management attribute their good engineer relations to five-day-per-week working and no night shifts.

". . . In line with this progressive thinking is Delta's approach to the problems of maintaining a 28-jet fleet in a five-day working week." Delta has three main workshops; one at the headquarters (seen in these pictures) deals with Convair 880s and DC-8s (above) as well as piston-engined types

After initial proving flights in November, Qantas is now operating a weekly service between Sydney, Mexico City and London, with stops also at Fiji, Tahiti, Acapulco (Mexico), Nassau (Bahamas) and Bermuda. Qantas Boeing 707-138B "City of Launceston" is seen here at Mexico City airport on an inaugural flight

AIR TRANSPORT...

BETTER YEAR FOR KLM

WITH a scheduled traffic increase in 1964 of 16 per cent—to 430.2m tonne/km—and an overall load factor increased to 51.7 per cent from 47.5 per cent in 1963, KLM has demonstrated progress towards recovery. Over the North Atlantic its load factor, at 70 per cent, was well above the average (66 per cent) for all the IATA carriers operating on the route.

Biggest increase was in inclusive-tour traffic, with a total of 36,000 passengers carried, or 40 per cent more than in the previous year.

LOADING ERROR CAUSE OF ACCIDENT

PROBABLE cause of the take-off accident to the South Central Airlines' Beech 18 on February 3 last year at Gainesville Municipal Airport, Florida, has been given by the CAB as the pilot's failure to ensure correct loading. The resultant overload and c.g. position caused the elevator to lose its effectiveness. The pilot and nine passengers—all of those in the aircraft—were killed.

The CAB accident report said, according to *Aviation Daily*, that the maximum permissible gross weight had been exceeded by 652lb and the centre of gravity was 8.2in beyond the rearward limit.

MEA EXPANSION PLANS

WITHIN the next two years Middle East Airlines will extend its services to South America, North Africa, Spain, East Africa and "certain countries behind the Iron Curtain." To deal with this expansion MEA proposes to buy at least five long-haul jet aircraft and to place options on two more—the first to be in operation by the middle of 1966. An announcement on the type of jet to be bought will be made soon. This was said recently by the airline's chairman and president, Sheikh Najib Alamuddin, in a New Year message to his staff.

MEA's revenue for 1964 exceeded £L95m (£11m)—an increase of £L10m over 1963. Sheikh Najib said, however, that the profit for 1964 would be less than that for 1963 because of the fuel strike in the Lebanon last autumn and the uncertain political situations in some parts of the Middle East.

US V/STOL STUDY GROUP MEETS

FIRST meeting of a US Government task force to study V/STOL aircraft in relation to the national transport system was held on January 14. This eight-member group is headed by the administrator of the Federal Aviation Agency, Mr N. E. Halaby; other members are the CAB chairman, Mr Alan S. Boyd; representatives of Army, Navy and Air Force Research and Development, of the Department of Defense and of NASA, and the Under Secretary of Commerce for Transportation.

The group has been formed to guide the future course of V/STOL progress in relation to commercial use. It will "define the national programme in terms of needs, priorities and timing; identify military V/STOL vehicles under development or study which appear appropriate for further civil development and use; recommend means of co-ordinating and implementing the research and development programmes of civil and military agencies to ensure that the goals of each are considered by the other; and establish a realistic development timetable to ensure that technical progress is incorporated into usable systems and vehicles."

The FAA recently demonstrated the feasibility of STOL operations by flying a DHC Caribou (loaned by the US Army) to and from the 550ft-long helicopter area at Dulles International Airport, Washington.

WORLD'S SECOND BUSIEST AIRLINE

WITH traffic increases of 25 per cent for 1963-1964, Trans World Airlines now claims to be the second largest airline in the world outside the Soviet Union in terms of passenger-miles flown. TWA now follows United Air Lines after overtaking Pan American and American Airlines during 1964.

The biggest increase for TWA during the year was that for freight, with a 36 per cent increase to 163.6m ton-miles. The growth of freight on its domestic services was greatest at 43.4 per cent with a total figure of 112.6m ton-miles. There was a gain of nearly 20 per cent in passenger numbers (8.1m) and of 25.5 per cent in passenger-miles to 8,617m. TWA's share of transatlantic passenger travel rose from 16.6 to 17.5 per cent of that of all IATA carriers on the route.

THIRD CARRIER RECOMMENDED FOR INDIA

THE air freight inquiry committee, set up some time ago by the Indian Government and headed by Mr S. K. Kooka, commercial director of Air-India, has recommended the establishment of a charter airline for India. This would be designed to promote exports by air and to provide low-fare services for tourists, students, seamen and others.

The committee had been asked to report on the feasibility of setting up such a carrier jointly by Air-India and the Indian Airlines Corporation. Its report said that participation by the two airlines would be against IATA rulings and recommended that the carrier should be a separate company—though it might be provided with paid-for-at-cost technical assistance by the two airlines.

One of the problems for the proposed airline would be that of maintaining two-way loads of freight because of import restrictions and the committee said that this problem might be overcome by concentrating on low-fare passenger charters to provide the reverse loads. It is estimated that the Indian Government would need to make a capital investment of about £75,000 for equipment and to provide a working fund of about £15,000 per annum.

FURNISHING AND FINISHING

In the following pages we present our annual review of current techniques and trends in the design and application of airliner interior equipment and decor. The articles, all written by specialists and ranging from general to particular aspects of the subject, cover passenger seating; decor (including wall trim, fabrics, lighting and detail fittings); galley layout and equipment; and the problems of designing the interior of the Concorde

SEATING—1

Problems in Passenger Seat Design

BY D. SAUNDERS AND K. McCULLOUGH*

WHEN a designer is faced with the task of producing a successful aircraft passenger seat he finds himself—more than with almost any other product—face to face with the hard facts of economics. No two airline operators agree on the features they wish to have incorporated in their seats and, since individual seat orders are relatively small, it simply is not economical to design a seat to suit each airline's particular specification. This means that the modern seat is a threefold compromise in its roles as an item of furniture, engineering considerations and the need to satisfy individual demands without losing money in the process.

One solution to the problem which has been adopted at Shorts is to produce designs which meet all the main requirements, but which have—engineered into them right from the planning stage—facility for easy modification to suit specific requirements. Some aspects of modern practice, such as the current trend towards clip-on upholstery, favour this approach, but on the whole the designer's task has been made much more exacting.

Possibly the most important development in recent years is the fact that airlines now offer different categories of travel. Before the general expansion of air travel there was only one class, but the development of the industry has necessitated some degree of specialization, resulting in three main seat categories—tourist, general-purpose and first-class.

These general categories can again be broken down to suit particular operators' requirements and each type may be so modified that it overlaps another group. The designer's problem in considering a new seat is to decide into which category it should fit and how best to meet the strength requirements—and also the operator's particular requirements—while still retaining maximum passenger comfort.

The tourist seat is for use where the operator wishes to carry the maximum number of people for only a short distance—say up to one hour's flight duration. To do this the seats require to be pitched as low as 28in and at this spacing a seat without recline facility is considered suitable.

The general-purpose seat must be suitable for use on all routes, including transatlantic, so maximum comfort is essential. A pitch of 32in to 34in is considered reasonable, with a reclineable back for the seat.

The first-class type is difficult to project in a standard version, as the operator requires maximum comfort with special emphasis on the relation of the design to his particular aircraft. In large aircraft a console could be provided in the middle of the double unit, whereas in smaller types this would not be possible. In any case the space available must be used to the best advantage to provide the expected degree of luxury.

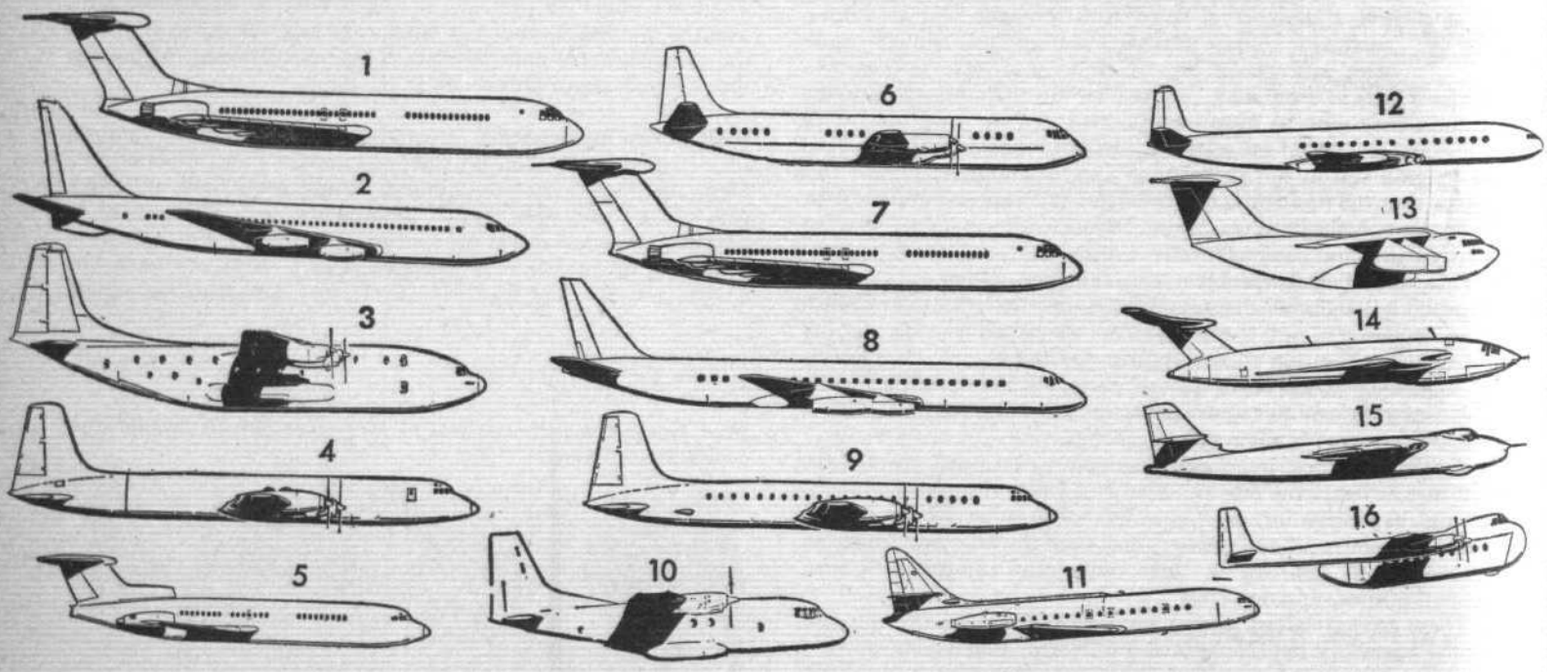
Basic Design Requirements Even when designing a seat to conform to a particular specification there are certain basic requirements. First, the appropriate airworthiness requirements have to be met with regard to strength; and, in this country, seats are designed to withstand an acceleration of 9g, whether forward or aft facing. A great deal of discussion is taking place as to whether or not this

Continued on page 92

Short Type 620 tourist-class seat for long-range aircraft, available in double and triple units

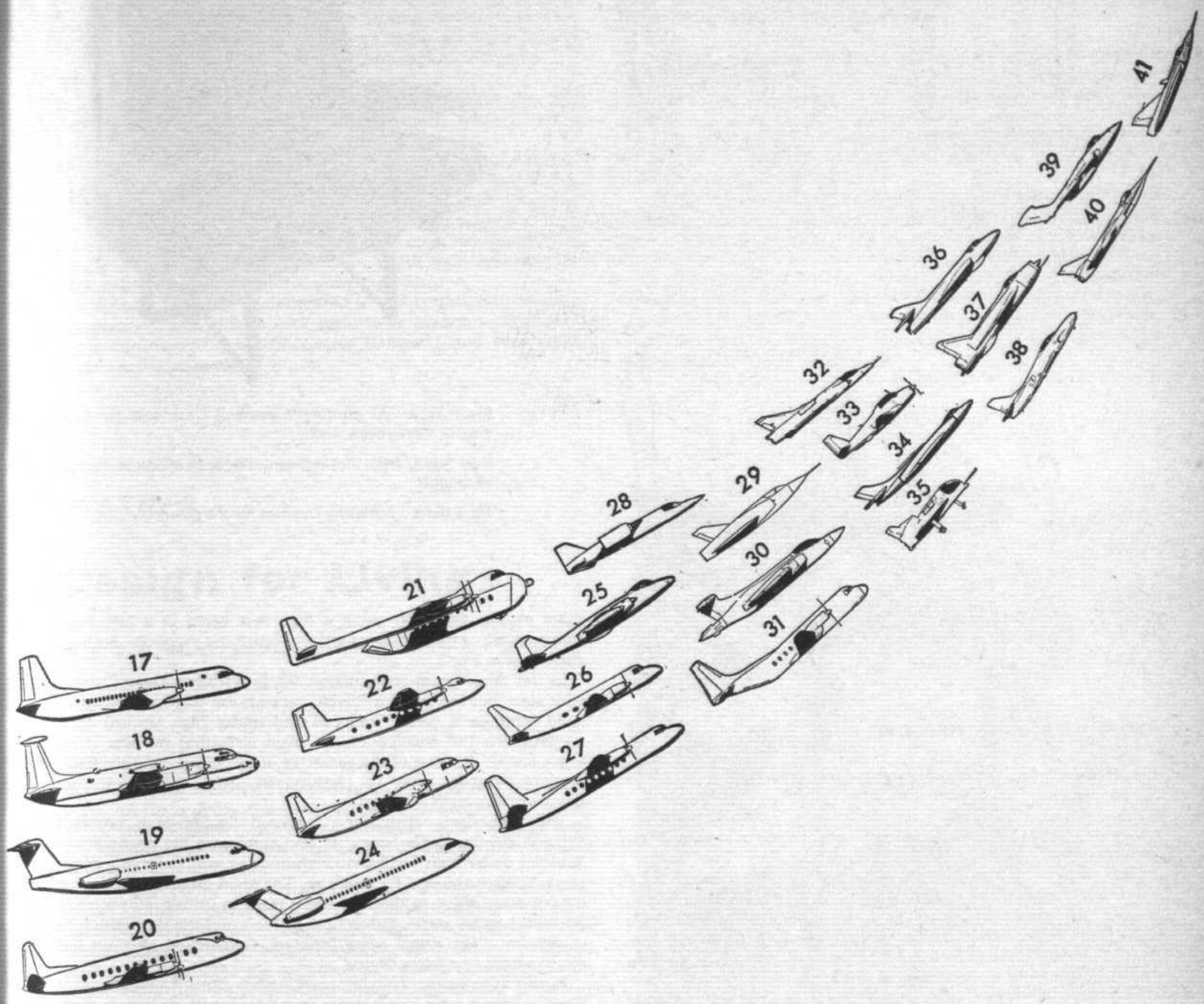
*Precision Engineering Division, Short Brothers & Harland Ltd.

International civil and military aircraft powered by ROLLS-ROYCE jet and propjet engines



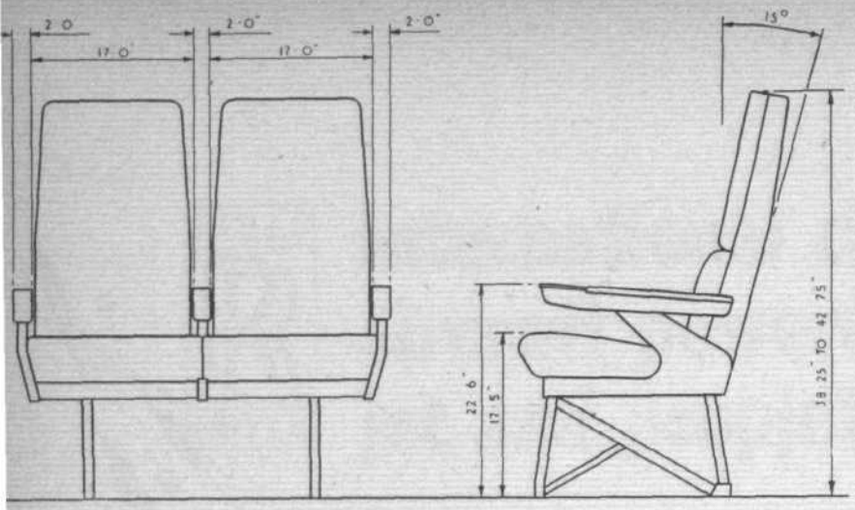
1. Vickers Super VC 10 ... ... *4 Conways*
2. Boeing 707-420 ... ... *4 Conways*
3. Short Belfast ... ... *4 Tynes*
4. Canadair Forty-Four ... ... *4 Tynes*
5. Hawker Siddeley Trident ... *3 Speys*
6. Vickers Vanguard ... ... *4 Tynes*
7. Vickers VC 10 ... ... *4 Conways*
8. Douglas DC-8/40 ... ... *4 Conways*
9. Canadair Yukon ... ... *4 Tynes*
10. Transall C-160 ... ... *2 Tynes*
11. Sud-Aviation Caravelle ... *2 Avons*
12. Hawker Siddeley Comet 2 & 4 *4 Avons*
13. Hawker Siddeley 681 ... *4 Medways*
14. Handley Page Victor B.2 ... *4 Conways*
15. Vickers Valiant ... ... *4 Avons*
16. Hawker Siddeley Argosy ... *4 Darts*
17. NAMC YS-11 ... ... *2 Darts*
18. Breguet Atlantic ... ... *2 Tynes*
19. Fokker F.28 Fellowship *2 Spey Junior*
20. Vickers Viscount ... ... *4 Darts*
21. Hawker Siddeley Argosy C.1 *4 Darts*

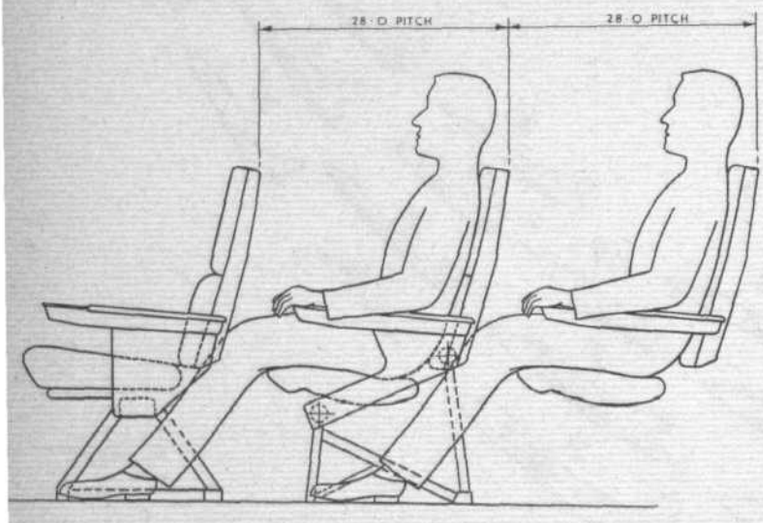
Every fourteen seconds a Rolls-Royce powered



22. Handley Page Herald ... *2 Darts*
23. Hawker Siddeley 748 ... ... *2 Darts*
24. BAC One-Eleven ... ... *2 Speys*
25. English Electric Canberra *2 Avons*
26. Grumman Gulfstream ... *2 Darts*
27. Fokker/Fairchild F.27 ... *2 Darts*
28. EWR Sud VJ 101C *6 RB.145s*
29. Dassault Balzac *8 RB.108s*
30. Hawker Siddeley Buccaneer S.2 *2 Speys*
31. Hawker Siddeley Andover *2 Darts*
32. Dassault Mirage III V ... *8 RB.162s*
33. Breguet Alizé ... ... *1 Dart*
34. Vickers Supermarine Scimitar *2 Avons*
35. Short SC.1 ... ... *5 RB.108s*
36. Hawker Hunter ... ... *1 Avon*
37. English Electric Lightning *2 Avons*
38. Saab Lansen ... ... *1 Avon*
39. Hawker Siddeley Sea Vixen *2 Avons*
40. BAC 221 ... ... *1 Avon*
41. Saab Draken ... ... *1 Avon*

airliner takes off or lands somewhere in the world





Short Type 720 ultra-light economy-class seat for high-density short-range work

Fig 1 (upper left) Basic dimensions for an adequate standard of comfort

Fig 2 (left) Achieving freedom for the passenger's legs

FURNISHING AND FINISHING

Problems in Passenger Seat Design . . .

factor should be increased; in fact, in Australia the requirement has been increased to 12g.

Seat structures, when tested, must withstand this acceleration without ultimate failure and after failure considerable deformation should have taken place, implying a measure of shock absorption in a crash. Some manufacturers are now applying the acceleration to their seats dynamically so as to investigate the actual amount of energy absorption which can be provided.

Secondly, the design must be free of any feature which would injure a passenger when thrown against it during a crash. It is highly desirable that all structural members at the seat extremities, and embellishments such as meal trays, should be adequately padded to give at least some measure of protection to passengers' heads, legs and arms.

Another major consideration in any design is the provision of an adequate standard of comfort. This, of course, varies according to the category of seat, but there are certain basic dimensions necessary for a reasonable seated position. These are shown in Fig 1.

Airline travellers will agree that the most important parameter is the width between arm-rests, and in any particular aircraft layout this is fixed by the fuselage cross-section, the number of seats across the aircraft and the width of gangway required—usually a minimum of 15in. It is normally possible to provide a seating width of about 17in, but this is often reduced because of the necessity for providing six-abreast seating.

Tourist Type To provide comfort at a pitch as low as 28in the seat cannot be considered solely in terms of the passenger using it; consideration must also be given to any restriction caused to the passenger seated immediately behind. To avoid restriction, the passenger's legs must be allowed the maximum amount of freedom and clearance, and to achieve this the base may be constructed in either of two ways—by using a high rear beam in a twin-beam construction, or by employing a single-beam construction. Both are illustrated in Fig 2.

In the single-beam construction the interference caused is at a minimum, but the space available beneath the seat for stowage of hand baggage is greatly reduced and under high vertical crash accelerations the position of the main structural member could prove lethal. Because of the geometry of its construction the back-support structure must be cantilevered from the beam, with unavoidable weight penalties.

The twin-beam construction favoured by Shorts is probably lighter than the single beam. It also eliminates the possibility of fatalities under high vertical accelerations as well as leaving ample space beneath the seat for stowage. The main disadvantage is that the leg attachment to the rear beam may, in certain athwartships positions, cause some obstruction to the comfortable positioning of the feet. The single beam form of construction also has this disadvantage to a lesser degree.

Access to very closely pitched seats is often difficult—which means that for tourist units the designer usually incorporates tip-up seats. In addition, because of the very limited room available, seat-back recline is not really practicable, so no particular purpose is served by providing a head-rest at the top of the seat-back. An advantage in omitting the head-rest is that the seat-back may be made short enough to allow freedom of visibility for the passenger, and the aircraft interior is thus given a more spacious appearance.

General-purpose Type For longer flights, and where it is desirable to provide a higher standard of comfort, the general-purpose type of seat is employed. The usual requirement is for these seats to incorporate recline through an angle of about 15°, the pitch of 32in to 34in allowing more leg-room for the occupant. In addition, airlines often prefer the unit to be capable of forward- or aft-facing installation to facilitate cabin layout.

As with the tourist seat, single, and double-beam structures are produced to meet this requirement—both types have their adherents and the advantages and disadvantages are mainly as previously described. However, as there is not the same necessity to provide leg room beneath the seat, the double-beam versions usually have the rear beam in a somewhat lower position to facilitate recline. This also makes it possible to reverse the legs to suit forward- and aft-facing installations.

Recline on modern seat designs is invariably controlled by a hydraulic mechanism which provides smooth and positive action

and also allows infinite adjustment within the recline angle provided. Rendering this item leakproof is a main consideration, because hydraulic oil can be very damaging to passengers' clothing. A criticism of recline in the past has been that the occupant tended to slide on the seat-back when the recline was operated, but this objection can be largely overcome by making the seat-back pivot roughly coincident with the hip joint—as in the new Short SM.620 seat. This feature adds appreciably to the standard of comfort.

First-class Seat Since it is usual to include a relatively small number of first-class places in an aircraft layout, weight is not as important as it is with other types of seat.

With first-class seats the demand is for maximum possible comfort; so apart from the cushioning being deeper and the covering more luxurious, the seating space is made wider to allow " fidgeting" room for the occupant. These seats are rarely produced as triple units and, at the most, four-abreast seating across the aircraft is the rule. It is possible to provide adequate width with wider armrests while still allowing the required gangway width.

Certain items can be incorporated to add to the convenience of passengers. These include such features as adjustable head-rests; centre consoles for magazines, etc; footrests; and even vanity mirrors and coat-hooks.

Bearing in mind that the type of seat we are discussing is used for long-distance travel, facilities for sleeping must be included in the design and most first-class units have a fully reclinable back. It is generally considered that a recline angle of 45° is a good compromise to allow a reasonable reclined position without interfering with the passenger immediately behind.

Upholstery As well as being a main factor governing the standard of comfort, upholstery plays a large part in the appearance and style of a seat. The present trend is for cushions to be filled with polyester foam with easily removable and washable covers, while the rear of the seat-back is covered with a one-piece plastic moulding into which the meal tray can be flush-fitted when stowed, giving a clean and pleasing appearance.

Upholstery forms a vulnerable part of any seat and easily sustains incidental damage. Consequently it is Shorts' practice to ensure that all items of covering are readily removable for repair. Whereas it was once acceptable merely to sew covering over the basic structure, it is now important that upholstery should be constructed in sub-units which can be attached to the structure by clips or screws. Spare upholstery items can then be carried by airline operators, enabling them to carry out on-the-spot repairs and increase the serviceability of their seats.

SEATS—2

Design for Living

By R. J. G. BRAY, MAIAA, AFRAeS*

THE airline industry's requirements, when coupled with those of the military transport, executive, helicopter and hovercraft operators, call for an extremely wide range of seats. The catalogue grows when the nature of the various types of operation is considered.

Whether it be the high-density commuter services, the coach-air industry, the "forward-facing IT, rearward-facing trooping" operator, the long-range two-class prestige airline or the humble bucket-and-spade trade, each demands seats to meet a particular need. The range of the seat manufacturer's products must, therefore, extend from the "royal carriage" type to the canvas paratroop bench.

To provide this extensive variety of seats, Rumbold, for instance, have produced, in the last 30 years, over 300 different designs, and are frequently called upon to make a further "one-off" to a pre-war pattern.

In assessing the present state of the art, one is forced, for reasons of production economics and the high content of skilled craftsmanship demanded for small-batch production, to focus on perhaps three or four basic designs, each capable of a limited number of variations to suit the operational requirements of a number of users. In this way, experience of serviceability, etc, is built up and a larger volume of production of a given basic design is achieved. Thus, the manufacturer is able to employ more comprehensive tooling and production methods than in the past.

At this juncture, we can refer to the title of this article: "Design for Living" implies two criteria for the seat designer, namely, survival and comfort, in that order. Survival can in this instance be interpreted as "crashworthiness," or the ability to provide the protection required under emergency alighting conditions as defined by the appropriate airworthiness authority. Additionally, of course, it is the duty of the designer to incorporate, within his weight and cost parameters, every further safety feature he can devise.

* *Chief Designer, L. A. Rumbold and Co Ltd*

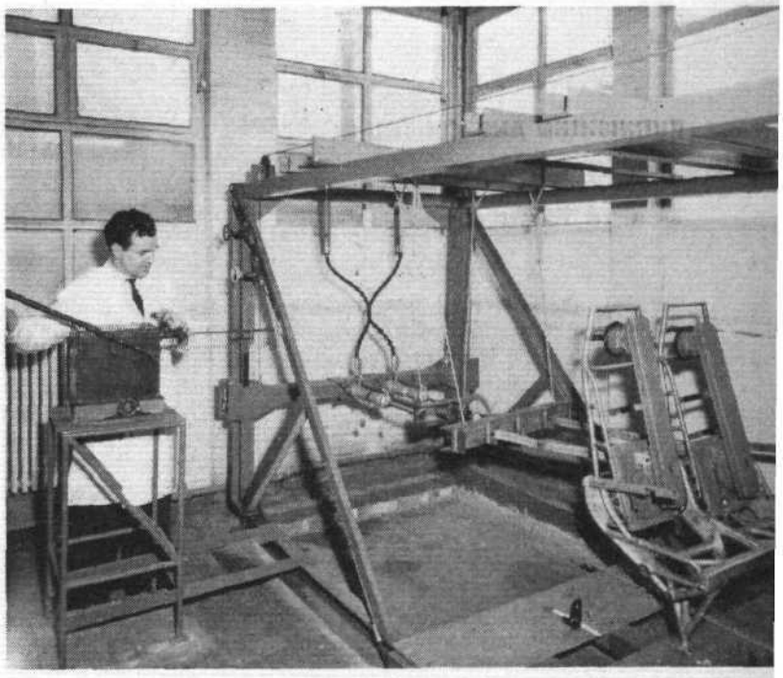


Fig 1 Seat test rig, utilizing DC-3 undercarriage jacks. A rearward-facing test of a Handley Page seat unit is in progress

Testing Airworthiness requirements demand that all prototype seats are subjected to structural testing in a static test rig to prove their integrity under specified factored loads. A hydraulic rig such as that shown in Fig 1 is often used. The loads can be applied incrementally and the deflections recorded to plot an energy-absorption diagram. Being conducted in "slow motion," the test shows the behaviour of the specimen in detail (Fig 2, overleaf).

Sometimes a "dynamic" test is called for by a prospective user, although airworthiness authorities do not as yet require this, nor indeed do they accept it as evidence of compliance. Such a test is usually conducted with the aid of a mechanically (NPL) or rocket-propelled (RAE) trolley. The duration of peak loads being of the order of a tenth of a second or less, quite sophisticated instrumentation, together with high-speed photography, is required to record the evidence provided by such an adventure. The results obtained usually show approximately a 1.3 factor when compared with static testing, and are necessarily of a confirmatory nature with respect to

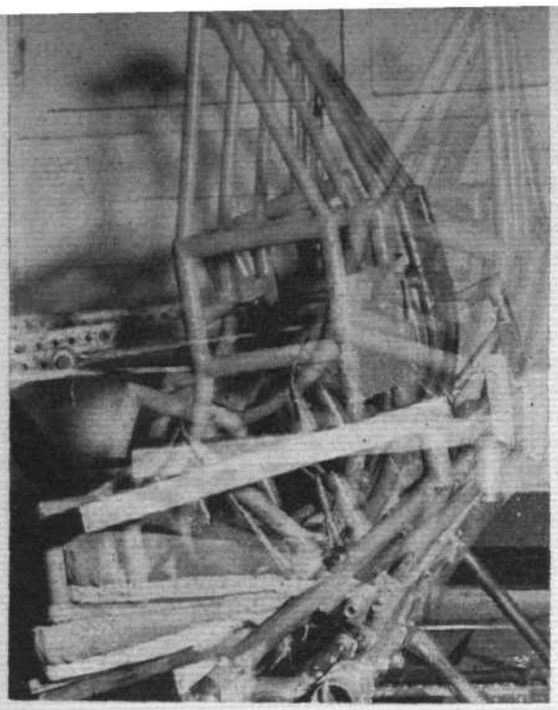


Fig 2 Double exposure showing deflection of seat structure between zero and proof loads. The tubular structure at the top is the "dummy carcase" to which the load is applied; it is bolted to the seat frame at the belt-attachment points

Fig 3 Typical tourist-class seat as used on the BAC One-Eleven

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the seat, although they must be of great value to the airframe constructor if the test vehicle utilizes representative flooring. In the latter case the test is proving the floor/seat combination.

Much emphasis has recently been placed on the capacity of the seat frame to absorb energy when exposed to high accelerations and it has been found possible to build-in a prescribed amount of resilience, thus relieving the aircraft floor attachments (and the seat occupant) to some extent. Fig 2 illustrates the nature of the deflections encountered at 12g forward on a triple seat designed on this basis.

Design Features Present trends indicate that medium-range aircraft (three- to five-hour stages) will have seats installed at about 33in pitch. This has become acceptable to the ticket-buying public largely because of the nature of the modern design, which provides a generous recess in the back of the seat ahead for knees and shins and also by reason of the infinitely variable type of hydraulic recline adjustment now in vogue, which enables the passenger to choose (within the range of movement) a posture to suit himself.

Seats used at pitches of this order are nowadays so equipped that the back-rests, when impacted from behind, hinge forward together with their respective meal trays, etc, thus minimizing crash hazards. Base cushions tip-up, cinema fashion, to facilitate access and the intermediate arm-rests fold between the back-rests to provide extra width when necessary.

For longer-range one-class aircraft (upwards of seven hours' stage length) similar seats tend to be employed at, say, 38in pitch, and having a higher head-rest. The greater pitch minimizes the intrusion of the higher head-rest into the living space of the passenger behind. The older method of recline action, in which the cushion slides forward, taking the bottom of the back-rest with it, has lately been revived by some manufacturers. This, of course, has the advantage that the head-rest does not encroach on the space behind. However, it does mean that a greater seat-pitch is required to prevent the occupant's knees and shins contacting the seat ahead. If space is available for this, then it is equally available for the conventionally mounted back-rest which merely pivots at the bottom.

On two-class aircraft the arrangements just described tend to be adopted for the tourist class, whilst the first-class installations consist of widely spaced double-seat units, often with a console cabinet fitted between passenger places. This console is sometimes used to house a closed-circuit television screen or individual radios with personal earphones. Such seats have also appeared with individual reading lights mounted in the head-rests, and also emergency oxygen systems built in and piped to the aircraft supply. Such is the degree of sophistication now involved with seat design. The weight penalties incurred for this sort of thing appear to be accepted willingly by some operators who, by reason of fixed-fare structures, resort to such complications to attract custom.

Passenger Appeal From the seat-maker's viewpoint, an approved seat can weigh anything from 12lb to 35lb per passenger-place, according to the degree of comfort; this is the second of the criteria previously referred to.

To cater for the anatomical variations encountered in accommodating passengers ranging from juveniles to obese adults is almost impossible. Design effort, therefore, tends to concentrate around the 95 per cent adult population (male), with reach dimensions and control loads to suit the female. There is a wealth of anthropometric data readily available to designers, and when this is used in conjunction with modern upholstery techniques it is possible to evolve a seat which will contour itself to the anatomy. Since there are few physiques that fit the datum average dimensions anyway, this is the only practical approach.

Under the heading of passenger appeal, it is as well to add a comment concerning the rearward-facing-seat philosophy. In contemporary airliners the acceleration of the take-off run and the steep angle of climb can be quite disturbing to the passenger "sitting with his back to the engine." However, this is more a question, perhaps, of operating technique rather than anything else. Whether or not there is any deep-rooted objection to facing to the rear is doubtful. This is borne out by a recent experience. Many readers will be familiar with the typical scramble to obtain a seat at the rear of the aircraft, this being considered the quietest and most desirable spot. A Viscount equipped with rearward-facing seats was boarded by a milling throng of passengers, the writer included; but in this instance the usual scramble was reversed, all the seats at the forward end of the cabin being claimed first. Once airborne there was no apparent motion and the deceleration during the landing run was made more comfortable by the seat configuration.

The additional weight of the higher (and stronger) back-rests which are mandatory for rearward-facing seats is of the order of 4lb per passenger. From the safety and comfort aspects this could be weight well spent when one considers the weight sometimes frittered away on gimmicks necessitated by the need to attract passengers from competitors operating the same pegged fares. Reverting to the facilities provided on aircraft seats, the writer has also noticed on several recent internal and Continental flights, of up to two hours' duration, that approximately 60 per cent of passengers did not change the recline angle of their seats. Either they were not adventurous enough to experiment or they had not been advised by the cabin staff that it was possible.

Construction and Maintenance The typical tourist-class triple-seat unit (see Fig 3) in current production, unlike its all-welded predecessors, is assembled Meccano-fashion from completely

interchangeable sub-assemblies and jigged components. Its legs can readily be re-located to suit various installational requirements; and apart from the main chassis cross-members all components are also applicable to the double variant. Spares stocks are thus minimized and, should a repair become necessary, a simple component change will render the seat serviceable while the defective detail is being dealt with in the workshop.

All soft furnishings are removable for cleaning, as also are the arm-rest caps. Side panels, which are subject to damage from baggage carried along the aisle, are of semi-rigid ABS (acrylonitrile butadiene styrene) material which can be washed, re-sprayed or replaced according to the severity of the damage.

All moving parts are lubricated with a molybdenum disulphide derivative. Adjustments can be carried out with the seat *in situ*. The hydraulic recline locks are filled with either DTD.585 or Skydrol, according to the operator's choice (the units are fitted with seals suited to the fluid selected).

In normal airline service no maintenance should be required—apart from cleaning, and rectification of damage caused by ill-treatment—except at intervals co-incident with major checks on the airframe at, perhaps, 3,000 flying hours. Experience shows that most damage or deterioration occurs when a seat is out of the aircraft, usually when being dropped from the doorway on to the tarmac or dragged across concrete. Another source of damage is the practice of trying to fit a distorted seat leg into a dirty track or socket with the aid of a fire-axe. This has become such an old joke in the industry that many seats are now equipped with "hammering pads" to absorb the persuasive forces applied to them. It is quite surprising how many operators find the need to remove seats or reinstall them between flights, even daily, when carrying mixed loads or changing from short- to long-haul configurations.

Attempts have often been made to meet the freight/passenger "split personality" requirements by the use of a seat which folds and stows against the fuselage side. These designs have been physically successful but have not been generally adopted—mainly because, even when stowed, they still occupy some space; and, of course, they consume payload. Furthermore, most types need to be inspected every time they are re-erected for passenger use.

Future Developments With the advent of the high-flying supersonic transport with relatively short flight times, and the economic necessity to carry as many passengers as possible in a high degree of comfort (because of the ticket price), a new concept of seat design may emerge. The projected subsonic airliner carrying 600 or 700 passengers on perhaps four- or five-hour journeys at a very low fare may equally well call for a re-appraisal of conventional practice.

Weight is an extremely important consideration in both cases. In the former (SST) case the basic structure would be very light to permit the embodiment of added comfort devices, and in the latter case the whole seat would probably need to be lightweight, in deference to the need for a relatively high-density layout demanded by the economics of the operation.

From this it appears that the SST seat could be based on the same lightweight structure as for the subsonic aircraft but would incorportate, perhaps, more luxurious upholstery. In both cases the effects of ozone—which, we are told, are greater at the higher cruising altitudes envisaged—will have to be investigated with respect to the upholstery materials. Even exposure to the ozone concentrations experienced at 25,000ft altitude level (ambient) will provoke premature perishing and hardening of some materials.

It is probable that there may be a need for passengers to wear safety belts at times other than take-off and landing. If this proves to be the case, a lightweight, mass-produced and inexpensive inertia-lock type of belt will be required. Such a belt permits the wearer a limited degree of gentle movement but applies immediate restraint should the movement become violent. It seems unlikely that there will be any great change in strength requirements for seats in the foreseeable future. The greatest practical advances will almost certainly be in the field of textiles and synthetic covering materials.

Naturally, all materials used for covering aircraft seats have to be flame-resistant. From the operator's point of view, it is also desirable that they should be stain-repellent. It is unfortunate that the siliconizing process as at present used to achieve the latter aim usually prevents textiles from absorbing the flame-resistant treatment. If pure wool is selected, because of its inherent flame-resistant tendency, it absorbs so much of the silicone treatment that it becomes both costly and heavy. That the textile industry will overcome these problems there is little doubt; and with the flexible-backed vinyl materials now becoming available in flame-resistant grades, it is reasonable to think that cleaner, lighter, harder-wearing, more comfortable seats can be anticipated.

That the aircraft-seat industry in Britain is not trammelled by convention is evident from the fact that it has survived the ups and downs of the aircraft industry; and because of its imaginative outlook and adaptability it is exporting 60 per cent of its output. This it has achieved by selling its own products wherever possible and not relying on the aircraft constructor to provide the market. One reason for such a survival is that the seat-maker's customer is almost "always right"; and all that the passenger is required to do is to sit down.

Interior Design SOME SIGNIFICANT CURRENT DEVELOPMENTS

THE furnishing group of a transport aircraft design office is one of the largest apart from the various primary structural design groups. Its interests range widely over those of both the structure and systems engineers but, unlike their environment, its code of design practice is built up largely from experience of customer requirements rather than being based on detailed regulations for strength and airworthiness laid down by the licensing authorities and standards organizations.

The interior design of a transport aeroplane epitomizes the necessity for properly combining experienced visual design with sound engineering practice. The industrial engineer is trained to solve visual problems of both architecture and colour, and most aircraft manufacturers and several major "initiating" airlines now employ a specialist designer from the outset of a new design. The British Aircraft Corporation has worked closely with an experienced American consultant design team—Charles Butler Associates of New York—for over ten years. The success of the decade-long partnership between the Corporation's furnishing design group, led by Alex Howie, and Butler's team is measured by the world-wide acceptance of their high standards of originality and ability to exploit the latest techniques in a wide range of applications through four generations of turbine-powered airliners.

The whole business of aircraft interior furnishing has now advanced to the stage where the traditional craft processes of "soft" upholstery have been replaced by production-engineered and prefabricated components with a high degree of interchangeability and improved standards of colour and décor. Manufacturers have made a very real effort to combine carefully the best known aesthetic ideas with sound engineering principles for satisfying passengers, maintenance engineers and, therefore, revenue accountants. The wide and spacious cabins of the big jets have set new standards which are being followed in all classes of airliner with accent on clean lines, flexibility of layout, ease of maintenance and rapid cleaning. All major items of equipment and fixed furnishings must be capable of quick removal without special tools.

Following the trend in specifying proprietary components for the aircraft systems, furnishing designers now compile stringent specifications for competitive tender for the supply of all furnishing equipment and raw materials. Although the mock-up technique has long been a primary tool of the furnishing designer, its use has now been greatly extended in the areas of functional design to complement these specifications. Today airlines not only ask for a job to be done but need it to be proved at an early stage. In addition, it is common practice to provide separate representative mock-up cabin sections for the differing décor schemes of individual customers.

Selling to the American market is of great value to the British furnishing designer. Not only do the US airlines set widely acceptable standards in general, but the US Department of Health has codified a comprehensive set of standards of hygiene and sanitation in its 31-page guide entitled *Handbook of Sanitation of Airlines* (Public Health Service Publication No 308). This covers the com-

An effective Formica "London 1647" black-and-white impression covers the transverse bulkheads of the passenger cabin of BOAC's Super VC10. The prefabricated sidewall trim, with integral air-conditioning and cornice lighting, is also seen, together with the "floating" overhead rack and the recessed and movable passenger service panels

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plete range of terminal catering preparation facilities and the culinary and toilet quarters and equipment in the aircraft. Since initial publication in 1959, supplements have been issued on potable (drinking) water systems and on galley details. The same department also publishes a comprehensive list of accepted equipment for interstate traffic on all forms of transport.

The cost of furnishing a current jet airliner, including design charges, is somewhere between 6 and 9 per cent of the basic price of the complete aircraft and works out as a furnishing cost of between £600 and £1,000 per available passenger seat. For an intercontinental jet the primary design input, to convert the bare structure into a fully equipped airline interior, may be as much as 200,000 man-hours—equivalent to 100 men for a year and to the total effort involved in a complete aircraft design of the 1940s—and a further 5,000 to 20,000 man-hours may be needed for variations from the initial "standard." Much of this prodigious effort is accounted for by the great depth of detail design.

The British ancillary industry has done well in keeping in step with the advancing standards of the aircraft manufacturer. The aircraft side of the companies involved is not normally their major effort. It is often a prestige subsidiary—but a pacemaker of experience and a typical example of the wider ramifications of the spearheading technological advantage which the aviation business offers to other allied industries. Practically all detail components such as mouldings, edging sections, fasteners and attachments must be specially designed.

Plastics have been highly developed as primary furnishing materials. Semi-rigid polyvinyl chloride (p.v.c.) plastics are now in increasing use for prefabricated cabin sidewall surfaces and formings. These are of laminated construction, the outer layers being of p.v.c. enclosing a decorative layer, the whole being pressed together to form a uniform sheet. The decorative pattern layer, produced by silk screen or roller printing, is protected by a thin external covering of clear vinyl which is impervious to moisture, abrasion, or staining by liquid, grease, or nicotine, and is easily cleaned. The US Polyplastex company provides an exciting range of patterns which are produced by combed random or woven patterns of natural grasses, synthetic fibres, metal-like strands, or multi-coloured flakes which are arranged by hand during the final laminating process.

A new decorative laminate, originally developed for aircraft interior furnishing by Boeing, is being manufactured exclusively by British Celanese in this country under the trade name "Boelite." All these materials can be easily cut and readily bent or moulded to single curvature with mild heat and without damage or embrittlement. The Formica range of resin-impregnated rigid laminated plastic sheet, using a clear melamine covering over the decorative paper insert, has also been used to good effect on bulkheads. Plastic coverings also provide attractive and durable surfaces for galley units.

Another new plastic development is pigmented glasscloth sheet. It can be made available with smooth, glossy, slubbed or leather grain surface finish with a similar appearance to vinyl cloth. The grained pattern is imprinted from a master pattern by a vacuum process while the resin is still wet. A unique BAC development is a lightweight plastic film mirror, which when mounted is only half the weight of a conventional glass mirror and is tough, unbreakable, non-misting, non-tarnishing and optically excellent over the large areas to which it may be readily fitted. There are numerous other applications of plastics for rigid mouldings and capping strips, particularly on seats and in other areas of potential hard wear.

Choice of Fabrics

Furnishing fabrics are available in a wide range of bright, fast colours, with which an airline can readily impose its own image on seat coverings and curtains within an otherwise neutral and restful fixed trim scheme. These are closely woven, giving a neat, tailored appearance. Suppliers must conform to rigid standards of composition, colour fastness, stain resistance, liquid repellency and rot-proofness, and both the ARB and FAA impose high standards of flame resistance. The materials must also be hard-wearing and readily cleaned and without a rough texture which will damage clothes or stockings. Opinions vary on the final choice. Some airlines prefer the cheaper expendable fabrics, which also allow a more frequent change of interior style, while others prefer the more expensive long-life materials. While wool carpets remain in wide use, the synthetic fibres are also being used. Colour-anodized metal trapping strips and nosings have proved to be both attractive and functional.

Although ARB- and FAA-approved materials are used wherever possible there still remains a vital job of visual inspection for colour matching. At Weybridge an inspection area has been set up for the purpose. This is equipped with fluorescent-tube colour-matching lighting for use by trained inspectors who are able visually to control the colour variation of large batches of raw materials with low reject rates. It is an unfortunate fact of life that the higher the grade

The "board-room" furnishing scheme for an executive BAC One-Eleven uses high-grade timber for the lower sidewall dado panel and transverse bulkhead, with single-tone plastic window panels (as on the standard airline aircraft) but with sliding curtains instead of integral translucent window blinds. The hat-rack is deleted in favour of single light-tone panelling of wooden moulding and vinyl cloth, while retaining the usual cool-air outlets

of finish the more obvious any deficiency in colour balance becomes.

Galleys account for a major part of the design effort. Up to 150 major meals and as many smaller ones have to be stowed in a confined space from which a very small service staff must produce "hotel service," but without the corresponding backing staff. Although washing-up is not required, the rapid handling of dirty equipment and waste is a formidable and space-consuming task if not carefully planned. The design of complete galley, bar and cabin equipment stowage areas on a current big jet may account for 40,000 man-hours. The end product shows that, to achieve the service standards of international airlines, up to 30lb of equipment weight per passenger is required to provide 2-2½lb of food and about the same weight of liquid refreshment.

In general, the equipment items can be bought and are reasonably standardized, but the basic structure has to be tailored to individual aircraft types. Most airframe manufacturers prefer to call in a specialist company at an early stage, but a high degree of design control is necessary, particularly over the numerous stressing cases because of the many combinations of inventory. The structural implications of a 15cwt load in a big jet galley under 9g design loading cases are comparable with those of primary airframe components of a complete aircraft of 20 years ago. Normally positioned at the extreme ends of the accommodation area, to allow maximum flexibility of seating arrangement, the various combinations of galley loading also have considerable effect on fore-and-aft balance.

Toilet compartment design has been much improved by designing all the features integral with, but readily removable from, the basic structure. Every item needs to be completely foolproof in use and free from potentially dangerous protuberances. For the BAC One-Eleven a new type of re-circulating flushing closet has been designed. This uses an air pump, operated by raising and lowering the lid, which exerts air pressure to remove the liquid. Only a ball valve is in contact with the liquid; the pump itself never comes into contact and corrosion is avoided.

Seating as an Art

A new generation of seats has come in with the jets. Paradoxically, airframe manufacturers no longer produce that part of the aircraft with which the passenger has the most intimate contact. Seat design is the specialized business of a small number of experienced companies. It has been elevated from an academic engineering study. Physical knowledge is much greater and a considerable amount of anthropological science is applied to the shaping, materials and safety provisions. Elaborate testing techniques have also been devised to establish crashworthiness and energy-absorption characteristics. Most seat manufacturers now incorporate some form of yield device which is capable of reducing the severity of crash impact so that the load applied to the floor attachment does not exceed its breakaway point.

The tip-up and single-spar high-density seats have been highly successful. Aircraft Furnishing Ltd has adapted its background of directly relevant experience of high-density seating to produce a "first-class" economy seat for the VC10. The primary structural member of this seat is a single spanwise spar located under the forward edge of the seat cushion. This eliminates all rigid transverse structure at the rear of the seat, being well away from the shin area of the passenger seated behind and providing considerably more comfort in close-pitched configurations. This seat has been described by many as one of the most comfortable in airline service today.

Aerotherm has also produced a significant innovation with its Zephyr II articulating seat, which operates within its own space cubicle. The seat-back is fixed in one position and the reclining action is confined within the seat of the passenger who wishes to recline, with no discomfort to the passenger behind. To achieve recline both the seat-pad and the lumbar portion of the back cushion move forward. A full 35° recline is obtained without compromising comfort or aesthetic aspects. For the first time, too, a passenger is able to eat comfortably from a stationary meal tray or stand up straight and leave his seat regardless of the reclining habits of the person in front of him. An added advantage of this seat is that it can be installed directly against a bulkhead, thereby saving 8in-12in of cabin space, and the last row is just as comfortable as the others. This also means that it is most suitable for fixed-back lounge applications or for use with a transverse cabin semi-partition attached to an intermediate seat-back. The idea behind this seat originated in a Weybridge requirement in 1956 for the Vanguard pilots' seats. Styling of the unit is by Charles Butler Associates.

Central African Airways is identifying the interior décor of its BAC One-Elevens with bush-man paintings, from old cave dwellings, reproduced on the side-wall panels. The colours fit into a carefully co-ordinated scheme by Charles Butler, which also blends with crew uniforms and service equipment

Detailed improvements in seat design include the use of moulded polyurethane foam for cushions and squab interiors instead of traditional fillings, and infinitely variable hydraulic recline mechanisms instead of springs or bungee rope with gated positions.

The most significant advance in interior lighting techniques in recent years has been the use of fluorescent lighting, operated from either d.c. or a.c. supply, instead of large numbers of individual filaments. Used architecturally, such as under the hat-racks of the big jets, these give a pleasing effect in reducing the "tube" impression of a long body by creating a greater impression of width and in reducing the otherwise oppressive effect of the necessarily large overhead racks which have to accommodate numerous recessed and movable passenger service items. It also gives an even distribution of light and avoids local blemishes on the furnishings. Control units are being perfected for these lights to provide a dimming capacity of up to 75 per cent of the light output, thus avoiding the need to provide complementary incandescent lamps for subdued lighting. Considerable use is being made of capless or wedge-base lights where individual filaments are required in confined spaces. The conventional metal cap is dispensed with and the electrical connections are made to the wedge-shaped elongation of the sealed glass bulb, with a consequent saving in space and weight. The use of electro-luminescent solid-state light sources for illuminated passenger notices has provided good legibility and there is virtually no heat dissipated. Just coming into use on civil aircraft is a compact radioactive light source. The low-energy Beta electrons emitted by an active element, tritium gas (an isotope of hydrogen), bombard and fluorize with a layer of phosphor coating the inside of the sealed glass envelope of the lamp, to provide a bright but bold light similar to conventional fluorescent lighting. These lights are entirely self-powered and have a useful life of about 20 years.

The specially appointed business jet is coming into its own and here the furnishing designer can once again revert to craft carpentry techniques with high-grade timber to provide a board-room atmosphere because weight is not at such a premium with the lower "payload." Unless the aircraft is exclusively designed for this role the interior design and trimming of these aircraft is generally executed by specialist companies.

Aircraft furnishing design and engineering is out of its swaddling clothes. It is a vital and accepted part of design right from the project stage. This is as it should be, for passenger comfort, well-being and convenience are the first and last objectives of commercial aircraft design.

NORMAN BARFIELD

FURNISHING AND FINISHING

Galley Design

GALLEY design is becoming an increasingly specialized aspect of the furnishing of modern aircraft. This is being brought about by the constantly changing demands of the operators' catering requirements in the various types of aircraft now operating on international and European services. To meet these requirements, lengthy negotiations are sometimes necessary between the operator and the galley design teams.

The galley structure must be a unit detachable from the aircraft. It is normally fixed to the seat rails and, on the larger types, also has roof-fixing devices. It is important that the unit be so constructed as to allow it to be taken in and removed through one of the cabin exit doors. In cases where larger galley units are required they are designed and manufactured to be sectionalized and final assembly is then completed in the aircraft.

Design teams are expected to include, so far as possible, decor-facing panels which blend with the chosen interior colour scheme. This also applies where, as in a large majority of cases, detachable bulkheads are called for.

The tendency in modern galley design is for the unit, when not in use, to be what is termed a "closed" one. This necessitates the introduction of up-and-over types of door which, when in the closed position, completely conceal all the detachable equipment—it is not normal, however, to conceal the electrical panels and steward-warning-light systems. In cases where operators do not require a "closed" type of galley, it is the normal practice for the auxiliary equipment, such as meal-tray containers and bar boxes, to be faced in the decor material. Stainless-steel finish to match the working surfaces is also a popular demand.

Basic Structural Requirements

Whilst the emphasis must first be on hygiene, much thought is also given to weight, durability and cost of manufacture of the unit. Dealing with the first requirement, the knock-down or solid board type of galley is not so popular, because joint sealing is extremely difficult. The designers, conscious of the possibility that bacteria might enter the unit, make every effort to ensure that, should the galley be of a framed type (normally stainless steel) the complete frame should be of a welded construction which becomes a fully sealed unit prior to panelling. When the panels or partitions are attached, a wet joint is made, and, after riveting or spot welding, a further seal is made at all mating faces by the introduction of a self-hardening compound, thus preventing moisture and foreign matter from entering the joints. In the majority of cases English designers recommend that all internal panels are finished in an epoxy enamel paint before and after assembly to the frame. This gives an added protection against corrosion and bacteria.

Particular attention is also given to the use of non-corrosive metals for such items as the main base frame, floor-fixing fittings and base panels, which are usually recessed so as to trap any spilt water, coffee, milk, etc. Some operators show a preference for bright or satin metal finish on all visible and working surfaces—in which case sterilization of the unit may be carried out by the use of a steam jet, which practice has proved to be practical and in no way detrimental to the structure, This type of cleansing cannot be used on wood or core-type material units.

Thus the galley and bar unit made in stainless steel has a definite advantage, being of considerable strength and meeting the full requirements of airworthiness authorities both at home and overseas. In this case it is only necessary to use a thin-gauge panelling, thereby combining strength with lightness. This type of unit also lends itself to easy modification at any time during the life of the aircraft.

It is inevitable that liquids will be spilt during service from the galley and therefore all working surfaces should be manufactured with generous radii for all corners and joints, and crevices should be avoided. Whilst most galleys should have a fully independent water system to give the catering staff dish- and glass-washing facilities as well as fresh water (in which case chlorinator units are sometimes introduced), the wise designer also provides a waste-water system to be drained either overboard or into tanks contained in a unit made easily removable for draining and cleansing at base.

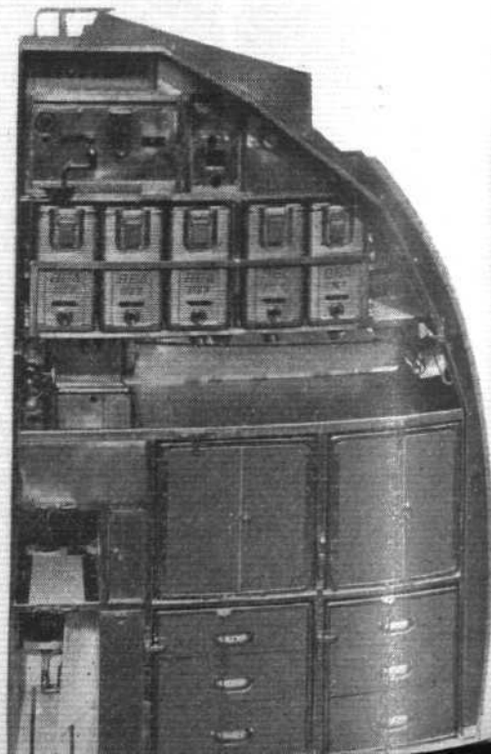
Weight plays an important part in the design of modern galley units, but it must not be at the expense of strength and durability. For this reason metals such as titanium are being used on a far wider scale than has hitherto been the case. Panelling, and indeed parts of the structure, can be made in this lightweight yet extremely strong material, thereby saving weight but retaining the required strength. Care must be taken in design, however—especially in the matter of certain welding difficulties.

To save unnecessary expense to the operator, galley designers are often called upon to provide suitable housing for easily stowable equipment. This is only possible when the equipment is of standard dimensions, so that the replacements will in no way affect the correct working of the galley. The carry-on type of equipment, such as meal-tray containers, bar boxes, hot-beverage containers, and hot food ovens, are so much in use that it is essential not only that they are more robust than ever before, but that they can be sterilized by steam jet. Henshalls of Byfleet have borne this in mind in their designs. Close dimensional limits are required in the galley and the bar units, as well as in the apertures to house equipment, so "go" and "no go" gauges to control these limits are used during the manufacture of the units. If the complete unit is not built in a boxed form jig, the unit is fitted into a jig both during the frame-making stage and after panelling and detail fitting; slip gauges are used at vital points. This method ensures continuity of working limits and guaranteed fitting in the aircraft.

Galley unit stressing is an important factor and this must be correctly calculated at the design stage and carefully maintained during manufacture. The advantage of the framed-type galley over other types of structure is that it will not move or alter its shape whatever its flying and service hours. It can be removed from the aircraft without detriment and refitted with the minimum of effort; damage to both frame and panels is easily rectified.

There are various forms of patented locks and fittings available—for example the "paddle" lock, which is a flush-fitting lock used for retaining meal-tray containers in position. The locking blade of the lock protrudes when the meal-tray container is pushed into position, and is released by means of a simple push-button fitted into the frame. This lock is also introduced for the hot beverage container, hot food oven and bar box. To fit the requirements of individual operators, a rapid water boiler can be fitted, as can hot cups and a refrigerator. Waste bins are normally provided, but tray stowage, Customs (sealed) boxes and hand sets are further items that can be provided if required. Stewards' foldaway seat and safety belts are often called for and can be incorporated in the structure.

Aircraft operators are rather inclined to allocate the least amount of space possible when galleys are mentioned—but the flight staff must be given room to work. The modern-design galley will give years of vital and first-class service. B.L.L.



Typical of designs discussed is this forward galley and bar unit for the Trident 1, by Henshall. For the Trident 1E an enclosed-front unit is supplied

Furnishing the Concorde

BY CHARLES BUTLER ASSOCIATES, DESIGN CONSULTANTS

THE privilege of being involved in the interior design of the Concorde represents probably the most interesting challenge of our collective design careers. Consider the aircraft itself. Even though seven or eight years away, it is close to the realization of putting man—with his usual business suit, suitcase, briefcase and all the rest—into a machine and flying him almost three times as fast as present airpseeds in today's comfort. Although the outside skin temperatures are very high, the interior temperatures will be similar to those of a VC10, One-Eleven, Trident and other present-day aircraft.

The pros and cons of whether to build a passenger-carrying supersonic aircraft have been discussed many times before—with the result that it is not a question of whether to build the supersonic transport—but how big, how fast and, really, how supersonic. The resultant BAC-Sud Concorde is an extremely neat package as a flying machine. Countless problems associated with this venture have been solved by the British and French technical specialists, but the fact remains that this is only the beginning for those concerned with the interior—and the above-mentioned subject of the isolation from excessive heat, thus providing comfortable cabin temperatures, is only one of the remaining problems that must be solved.

The Long Tube

Consider a fuselage long enough to accommodate up to 120 passengers at a comfortable, four-abreast seating. Now, this is 30 rows of seats, with perhaps only a single break amidships. Many or all of us who are concerned with this interior project have had the long tube to work with in the past. Consider the fact that we have, now, a long narrow tube almost twice the length of those previously encountered. The first, most obvious, approach is, of course, to spend considerable time and study on the fuselage section. In today's long-range aircraft, with fuselage sections larger than that of the Concorde, we have the problem of concealing required ducting, air-conditioning, passenger-service items, electrics and emergency oxygen, to mention a few. All these same items must be considered and included in the smaller section of the Concorde—which means that every skill possible must be used in co-ordination with technical groups, and the interior styling groups, to make this section look as large as possible by designing everything to be as unobtrusive as possible and by locating everything as far outboard as possible. There will be an overhead rack which will incorporate all passenger-service units within easy reach and, also, be able to contain the required lightweight passenger items.

The curvature of the sidewall must be considered in relationship to the contours of the passenger seats in order to gain as much width per passenger place as well as adequate aisle space. It is possible, to some extent, to create the illusion of cutting down the length of this long interior tube by use of colour breaks in large areas, but, in the main, this is not too effective. It is also possible, of course, as is at present done, to incorporate the use of bulkheads in breaking up areas, but in this case we generally wind up by losing a seat row. We therefore feel that something should be done by creating a sort of a semi-partition, either from the top of the seat, or from the hat-rack, perhaps in a translucent form which will arrest and entertain the progress of the eye down the long interior.

The subject of lighting will be extremely interesting, because we have a stringent limit on the power drain and therefore, if possible, the lighting should come from an extremely simple but effective overhead and, perhaps, indirect source.

Now we come to the subject—the most difficult of all—that of weight. In today's aircraft we have examples of weight throughout the entire passenger area, broken down into pounds per passenger. In most of today's aircraft these run anywhere from 105lb per passenger to 140lb. The problem of all those concerned in the interior design of the Concorde will be to reduce this weight by approximately one-third. Now, in order to do this we must change our collective thinking from today's habits.

Logically, the approach would be to use less material, of a much lighter, but yet durable, nature. We would like to feel that the final materials to be used on the interior of the Concorde do not really yet exist and that we will be able to work with British and French manufacturers to come up with what we hope to be a completely different set of specifications for interior trim. Ounces are as precious to us as pounds used to be and you can be sure that they will be spent with the greatest of reluctance. However, in trying to reach our goal of the desired weight we cannot overlook the fact that these aircraft will be used almost on a turn-around basis and that the materials we install in the interior must be as durable as, if not more durable than, those used today. We are certain we will receive the desired co-operation from all the European manufacturers in our attempt to produce this interior within the desired specification.

Seating: a New Approach

Passenger seating will be a subject of great consideration. Again, we think we will probably disregard all concepts of aircraft seating among those manufactured up to now—or at least that is the way we would like to think it will be. In the first place we feel that, with a new approach to seating, a considerable part of the weight saving can come from this programme. For one thing, the Concorde passenger will not be seated for the length of time currently required for a trans-ocean crossing. Perhaps the seat will not be asked to perform exactly as it does now for the average passenger, but we do not by any means consider this to be a reason for lessening of the comfort features of the seat—it is just that we feel that by some different and clear thinking we can, and will, come up with something new. Certainly, new materials, from a structural standpoint, must be gone into thoroughly, as well as considerations of new seat structures. Outmoded existing concepts, such as cut and trimmed foam padding, slip covered with a heavy upholstery material, will be thoroughly evaluated and, of course, the attitude of the aircraft during all phases of flight will have considerable influence over the performance required of the seat.

Another fact which could have an important bearing on weight-saving is that certain airlines, because of the nature of their route structure, may require fewer lavatories in the Concorde than in current long-haul types.

Food and Entertainment

Feeding the passenger and providing entertainment will, of course, be up to the individual airline operator. As it stands now, we do not believe that any purchasing airline has really decided how it will approach the subject of providing beverages and whatever food for the passenger. Depending upon the quantity and qualities stipulated by the individual operators, here again is an opportunity to come up with something new. We look forward to completely different types of food and beverage containers and, also, to different means of getting them to the passenger, thereby eliminating much of the weight and bulk that exist in many of the ponderous galleys of today.

When we refer to entertainment, we mean this in the sense of closed-circuit television or in-flight films as presently provided. We are convinced that, by the time the first commercial flight of the Concorde occurs, we will have many new approaches to this situation.

Providing the proper feeling of living space within this fuselage will be no easy task. Certainly, as mentioned at the beginning of the article, it is the most interesting challenge we have had to meet so far.

We have been closely associated with the British aircraft industry for the past 12 years and we look forward to an even closer relationship with the engineering and interior design groups within the British Aircraft Corporation, and their French colleagues. Robert Price, who managed our London office for a few years, and the rest of our staff at present working on British aircraft interiors, will be engaged in this project.

In a few years' time, there is no doubt that flying in the Concorde will be a most memorable experience. We are virtually enjoying that experience already.

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Control of NASA's Mariner 4 spacecraft is exercised from this room—the Space Flight Operations Facility at the Jet Propulsion Laboratory in Pasadena, California. Radio commands are transmitted via 85ft diameter aerials at Goldstone, California; Johannesburg and Woomera

3. Sixty-three Million Miles in Thirty-six Days: a Progress Report

MARINER TO MARS

MARINER 4 was launched from Cape Kennedy by Atlas Agena D at 9.22 a.m. Eastern Standard Time on November 28, 1964. Five minutes later, following Atlas burnout, a magnesium-alloy shroud around the spacecraft was jettisoned. The first major hurdle on the 325-million-mile obstacle race towards Mars had been overcome; 23 days earlier, the launch of Mariner 3 had failed because the spacecraft's glass-fibre shroud had remained attached.

Six minutes after lift-off, the Agena second stage fired to inject Mariner 4 into a parking Earth orbit. Thirty-two minutes later, at 122.8 miles over the Indian Ocean, the Agena fired a second time to place the craft on its planned trajectory. At Agena cut-off, Mariner was travelling at 25,598 m.p.h. relative to Earth; its signals showed that it would pass within 151,000 miles of Mars if no course-correction were made.

Forty-five minutes after launch, separated from the burnt-out Agena stage, Mariner 4 began to deploy its four solar panels for the flight. Within 16min the panels were fully deployed and the nitrogen gas jets of its attitude control system had oriented the panels towards the Sun (thus orienting the spacecraft on its pitch and yaw axes but leaving it free in roll).

Now it had to "lock on" to the star Canopus, chosen as a reference point because of its brightness and suitable position in relation to the Earth and Sun. Mariner was equipped with a light-sensing instrument able to detect variations in star brightness, which could be commanded to take a second look for Canopus should it lock on to the wrong star at the first attempt.

As programmed, the spacecraft's central computer and sequencer ordered the search for Canopus to begin 16hr 37min after launch. At 1.59 a.m. on November 29 the Canopus sensor was pointed in such a direction that the spacecraft would have to roll approximately 293° to find Canopus (the craft is programmed to roll slowly in one direction only—anticlockwise, as viewed from the Sun).

Shortly after Mariner began its controlled roll, it detected the Earth's reflection—but sensed that the light was too bright, and continued its manœuvre. After 8min, at a roll angle of 100°, it locked on to a star. This was about the dimmest possible star which could hold Mariner's Canopus sensor. The Jet Propulsion Laboratory's Space Flight Operations Facility at Pasadena, nerve-centre of Mariner flight operations, identified the star as Aldemarin. Since the star was so dim the JPL experts believed that the spacecraft would lose lock of its own accord and, in fact, Mariner began its rolling search for Canopus again 5½hr later—at 8.13 a.m. EST on November 29.

After a 107° roll lasting 16min, Mariner locked on to the star Regulus. Again the brightness scale was low, and project officials decided to wait one day before commanding Mariner to continue its search for Canopus. On November 30 at 4.14 a.m. Pasadena transmitted this command; after a 60° roll lasting 7min the craft locked on to the star Naos in the Milky Way. At 5.45 another search command was given; in 1min Mariner rolled 7° and fixed on to a cluster of unnamed stars in the Milky Way.

At 5.58 it was again ordered to search and at 6 a.m. on November 30 the light sensor was attracted by the glow of a star, 100 light-years away, nicknamed the Yellow Giant. This was Canopus, and (at the fifth attempt) Mariner locked on, now stabilized about all three axes. The craft was about 380,000 miles from Earth at this time, travelling at 7,360 m.p.h. relative to the Earth.

For the next three days NASA's 85ft tracking aerials at Goldstone, California; Woomera, Australia and Johannesburg, South Africa were used to track the spacecraft, accurately measuring its trajectory and determining that all parts were functioning well.

On December 3, as Mariner neared the million-mile point of its 325-million-mile journey, it was decided to attempt the midcourse correction intended to result in a closer approach to Mars. For this purpose, Mariner carried a small liquid-propellant motor which could be fired for very precise periods.

The midcourse manœuvre began at 8.05 a.m. EST on December 4, when Mariner 4 was 1,084,344 miles from Earth. Firing of the motor would shorten the flight time by two days, and the craft would fly past and behind the planet instead of continuing on its present trajectory which would take it ahead of Mars.

At 5min intervals, beginning at 8.05 a.m., the Goldstone station transmitted three quantitative commands to Mariner for it to store in its central computer and sequencer. These commands, designated QC-1, 2 and 3 called for Mariner to release its lock on the Sun and Canopus and to orient itself to fire its rocket motor.

The QC-1 command would direct Mariner to release its Sun lock and slowly pitch down about 44°. QC-2 called for the craft to roll 156°, and QC-3 programmed Mariner to fire its midcourse motor for 20.18sec. After the spacecraft acknowledged that it had stored these commands, two further commands were sent to prepare for the manœuvre. These called for immediate action and were designated direct commands (DC). At 8.45, signal DC-29 armed circuits to the midcourse motor. At 9.15, DC-14 removed an inhibition which had been placed on the midcourse correction system since launch so that it could not accidentally be triggered. Another "inhibit" command, numbered (perhaps appropriately) DC-13, was available for use prior to the motor burn to cancel the manœuvre in case of difficulty.

All was now ready to begin the midcourse manœuvre. Another command, DC-27, was prepared. This would transfer control of the manœuvre to the spacecraft itself. The DC-27 signal, sent at 9.35 a.m., switched on Mariner's gyros so that the spacecraft could control its attitude without reference to the Sun and Canopus. It also switched telemetry signals from scientific information from the experiments to all engineering data so that project officials could have the maximum information about the spacecraft during the

critical manœuvre. DC-27 also started a "countdown" by the central computer and sequencer to begin the actual manœuvres about 1hr later.

Suddenly Mariner reported that it had lost its lock on Canopus, and had begun rolling. As soon as this was confirmed the DC-13 command was transmitted to the craft, cancelling any further events in the midcourse manœuvre. The Canopus sensor then locked on to another star, was commanded to search again, and locked on to three other stars in succession.

At 11.06 a.m., project officials left Mariner locked on to the fourth star in order to study the situation. By 5.40 p.m. it had been decided to continue the search for Canopus in order to prepare Mariner for another attempt to make the midcourse manœuvre on the following day, December 5. After seven DC-21 signals—commanding Mariner off other stars which it had acquired—the spacecraft found Canopus and locked on to it at 6.59 p.m. EST on December 4.

A second attempt to perform the midcourse manœuvre began early on December 5. Quantitative commands QC-1, 2 and 3 were sent to Mariner for storage in its central computer and sequencer at 5min intervals beginning at 8.05 a.m. EST. They called for the craft to pitch down 39.2°, roll 156.08° and fire its midcourse motor for 20.06sec. Direct commands then armed the firing circuitry and removed the inhibition on the midcourse manœuvre.

At 9.25 a.m. on December 5, command DC-27 started Mariner counting-down for the midcourse manœuvre. This time the craft remained firmly locked on Canopus and the Sun. As directed by the central computer, Mariner broke its lock on the Sun and Canopus at 10.25 and pitched down for about 3min 46sec. At 10.47, under gyro control, it slowly rolled for about 14min 9sec. At about 11.09 the midcourse motor burned for just over 20sec and cut off.

Twelve minutes later Mariner reported that it was locked on to the Sun again and was starting a slow roll to reacquire Canopus. At 11.55 a.m. the spacecraft reacquired Canopus and the midcourse manœuvre was complete. Time taken, 3hr 50min.

The midcourse manœuvre resulted in a flight-path which, it was calculated, would bring the spacecraft to a closest approach within 5,400 miles from the Martian surface. A second midcourse manœuvre would have been possible but, it was now clear, would not be required. Time of closest approach to the planet was now calculated to be 8.11 p.m. EST on July 14, 1965.

On December 7 telemetry showed that one of the eight scientific experiments aboard the spacecraft had failed—the first unfavourable report to be received from Mariner. The solar plasma probe instrument, designed to measure protons streaming out from the Sun, ceased transmitting intelligible information, apparently because a small electronic component had failed.

At 7.30 a.m. the same day Mariner reported that it had temporarily lost its lock on Canopus. Such an event had been expected from time to time by project officials, and would not affect the course of the craft towards Mars. Under gyro control the spacecraft rolled 342° in 44min, locking on to Gamma-Velorum, another bright star. Since the Canopus lock was not crucial at that point of the flight, Mariner was not immediately commanded to reacquire the star. It was believed that a minute dust particle, glinting in the Sun, had momentarily distracted the light-sensitive instrument.

On December 11 and 12 Mariner 4 passed through the first of three known meteoroid streams it was expected to encounter during the 228-day flight to Mars. Data from a cosmic dust detector aboard the spacecraft confirmed its passage through the stream.

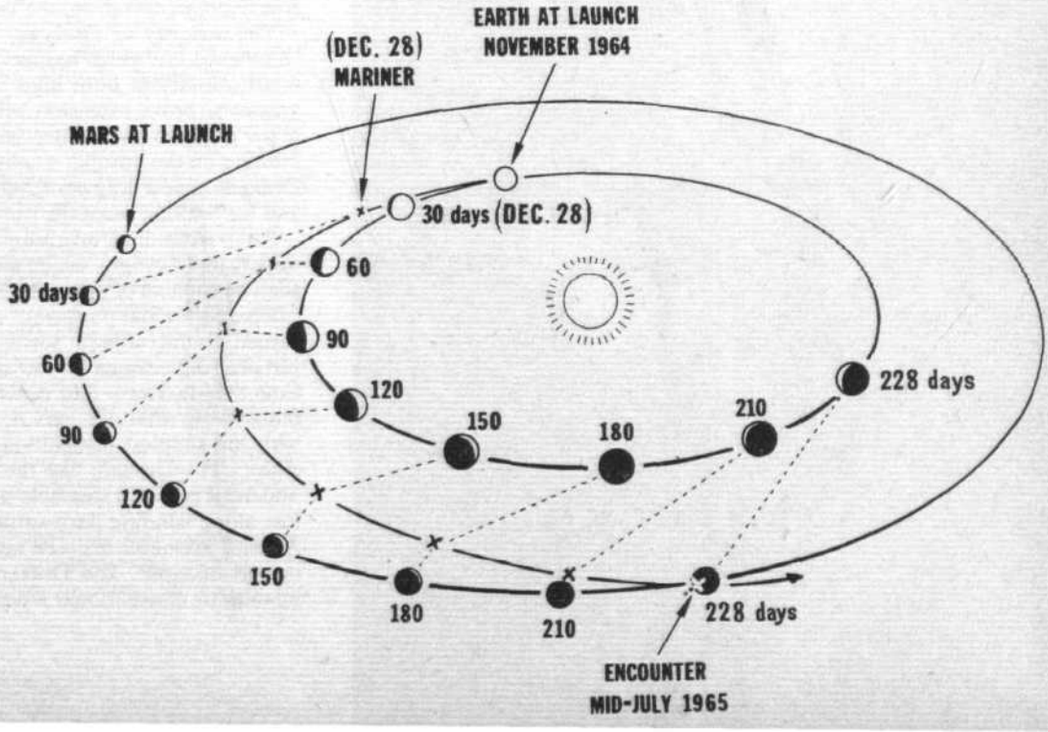
Radio transmitter power aboard Mariner 4 was increased on December 13 when a DC-7 ground command ordered the spacecraft to switch from a cavity amplifier, which had been used since launch on November 28, to a travelling wave tube amplifier.

On December 17 two commands were transmitted to Mariner 4 in an attempt to reacquire and retain the fix on the star Canopus. A DC-21 signal at 11 a.m. EST commanded the tracker to break its lock on the star Gamma-Velorum and go into a slow rolling search for Canopus. Canopus was reacquired 3min later. The second command, DC-15, was sent at 12.30 p.m. and was designed to deter the spacecraft from losing its lock on Canopus again by reducing its sensitivity to small dust particles which might reflect flashes of sunlight into the sensor. Both commands were prepared in the JPL Space Flight Operations Facility at Pasadena and transmitted from NASA's deep space network station at Woomera.

On December 20 Mariner 4 began to pass through a second stream of meteoroids. During its first 23 days of flight it had made approximately 7.5 million scientific and engineering measurements and transmitted them to Earth. At 9 a.m. on December 20 the craft was 3,748,352 miles from Earth, travelling at 6,970 m.p.h. relative to Earth. The straight-line distance from Mariner to Mars at that time was 107,592,980 miles.

On December 27 Mariner 4 passed the 50-million-mile point on its 325-million-mile flight. At 9 p.m. EST on that day the spacecraft was 5,011,636 miles from Earth, moving at 7,186 m.p.h relative to Earth and 72,025 m.p.h. relative to the Sun. Project officials reported that the craft was operating normally and had retained its lock on Canopus since the December 17 command.

Since its launch, Mariner had been transmitting information at the rate of 33⅓ bits per sec. At 11.59 a.m. EST on January 3 the central computer and sequencer was programmed to change this rate to 8⅓ bits per sec for the remainder of the flight. This was the first command to be initiated by the spacecraft itself since the midcourse manœuvre on December 5. At 9 a.m. on that day Mariner was 6,156,704 miles from Earth, having travelled almost 63 million miles; after 36 days in space the craft was continuing to operate normally. *[Previous articles, November 19 and December 3]*

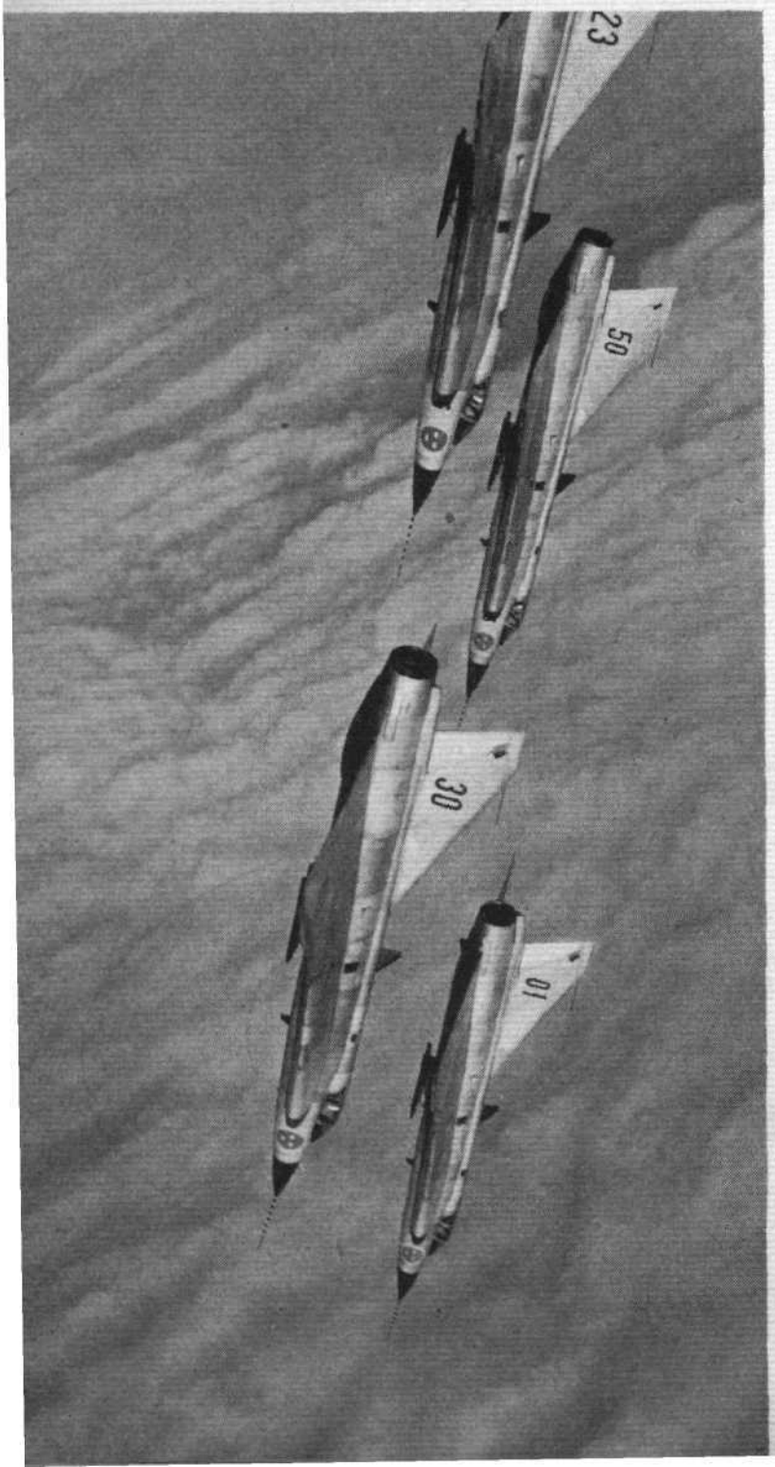


Mariner 4's trajectory to Mars. The spacecraft is expected to pass within 5,400 miles of the Martian surface at 8.11 p.m. Eastern Standard Time on July 14

IN THE AIR

By Mark Lambert: Number 191 of the series

SAAB DRAKEN



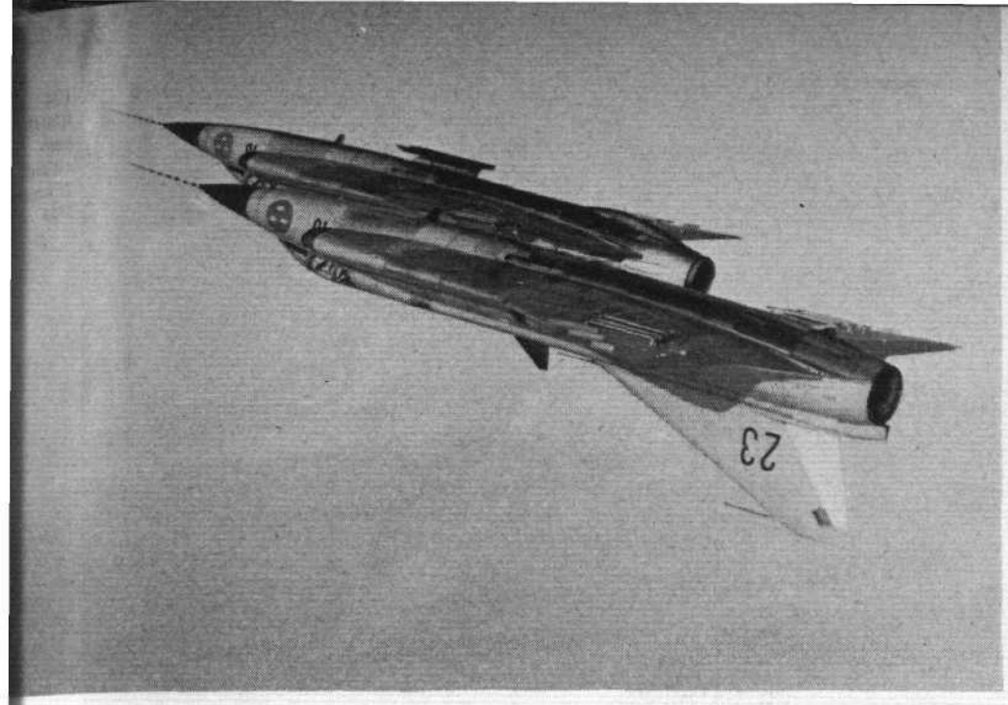
AS is the case with all good basic designs, the Draken has shown considerable development potential. Although the first J35A—Adam in the Swedish phonetic alphabet—is admittedly a fairly basic aeroplane in terms of control systems and armament, it was soon joined by the B; and most As and Bs are now being modified by Saab to D standard—phonetically David. The two-seat trainer Sk35C, which I recently flew at Uppsala, Sweden, is a modified A with no radar, little weapons capability, and few of the improvements typical even of the A. Powerplant is the Svenska Flygmotor RM6B (Rolls-Royce Avon 200) with Swedish afterburner.

The David incorporates improved controls and autopilot and, most important, the S7 fire control radar permitting collision-course attack—a vital necessity in view of the very short warning time available to Sweden. Ultimate development, incorporating every possible refinement and especially the licence-built Hughes Falcon collision-course weapons, is the F—Swedish Filip—production of which is now beginning following extensive trials with two prototypes.

Numbers produced and rate of production are secret, but it can be said that the Saab factory is running three production lines with a total of 36 final assembly stations, approximately one-third of which are for re-manufacture of J35A and B to David standard. Two wings of Davids are now in service, but the Filip will be the most numerous single variant built and will continue in production until at least 1968. A modest number of S35E reconnaissance Drakens are also being built. From the point of view of operational effectiveness, therefore, the best of the Draken is still to come.

The majority of Drakens, except the two-seater, now have the lengthened tail which reduces drag at high speed, improves longitudinal stability at both high and low speed, and makes possible a greater airbrake extension without troublesome buffet. In order to allow pilots to use the maximum nose-up attitude for aerodynamic braking on the ground, a solid-tyred diabolo tailwheel is fitted. All Drakens have a drag parachute for use in emergency on dry runways and for braking when the runways are icy.

An outstanding operational feature is the quick-reaction and dispersal philosophy which dictates that all Swedish tactical aircraft shall be capable of operating from several hundred stretches of road (prepared for the purpose), scrambled at a moment's notice and turned round after a sortie in the shortest possible time. The physical dimensions of the aircraft are therefore dictated to some extent by taxiways and runways of very limited width, storage in remarkably small hangars or underground caves and maintenance with the simplest installations and by relatively unskilled groundcrews. The Draken, like the J29 and Lansen, has a narrow-track undercarriage and steerable nosewheel and can be taxied extremely fast along winding hard-surfaced tracks to hideouts in the forests. Aircraft are never exposed near a runway unless they are ready for instant take-off. The Draken can be refuelled and reloaded with missiles or conventional weapons in three to four minutes.



Certain observed figures of power settings, speeds, times and fuel states normally appearing in our "In the Air" series, are omitted at the request of the RSAF

"Flight" photographs by Michael Barnes

This year's official RSAF aerobatic team, from F-16 wing at Uppsala, fly up, over and down in a loop for "Flight's" cameraman in a following Lansen. Weapons include rocket rails and central Sidewinder launchers. The Nos 2 and 3 have long tails

J35A and B Drakens have the S6B fire control and Lear basic attitude-holding autopilot allowing conventional lead-pursuit attack with guns or unguided rockets. At a fairly early stage in development this armament was supplemented by Sidewinder infra-red missiles imported from the USA; and an infra-red sensor, mainly used at night, is mounted beneath the Draken's nose, partly to improve sighting and partly to maintain weapon effectiveness during countermeasures activity. Though the David has collision-course radar, it still uses lead-pursuit weapons.

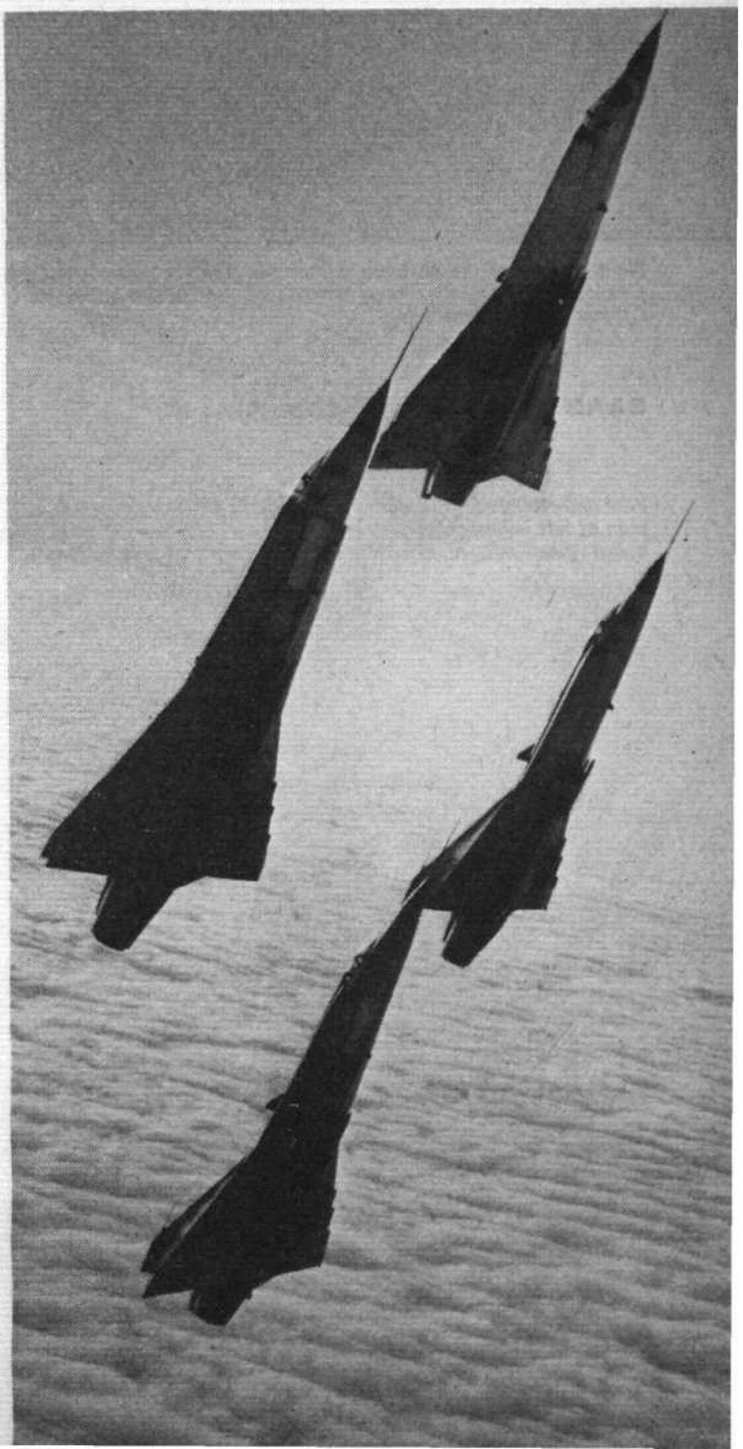
Because the Draken has a dual intercepter and ground-attack role, the gunsight is capable of giving range, drift and trajectory compensation for guns or 5in rockets. Finally, guns or other weapons are intended for air-to-air use against slow-flying transport aircraft, helicopters and similarly vulnerable targets. Other external loads include bombs and tanks—the latter because tactical wings must be capable of rapid movement to fairly distant bases.

The David additionally has much more advanced instrumentation and a high-capacity data link system integrating the aircraft with the STRIL 60 ground environment and giving excellent protection against countermeasures. The Filip interception system is designed around the Hughes Falcon, produced under licence by Saab as the RB27 radar-guided, and the RB28 infra-red homing system. The 27 is the same size as the nuclear-tipped Falcon and each Draken normally carries two on fuselage pylons for high-level, collision-course interception. Because of limitations in heavy countermeasures and close to the ground, each Draken also carries an infra-red homing RB28 under each wing to complete its interception capability over the full band of heights and tactical situations. Both David and Filip versions are also fitted with the RM6C (Avon 300/RB.146) engine with Swedish afterburner conferring considerably improved rate of climb, altitude capability and a maximum level Mach number beyond 2.

In view of the slightly complex modification process described above I was gaining only a general introduction to the Draken series by flying the unmodified, radarless two-seater—a point probably well understood by the highly security-conscious Royal Swedish Air Force, which granted me the facility. Nevertheless, I was able to have two sessions in the J35A flying simulator and to make two flights in the rear seat of the two-seater. At the same time, the RSAF specially prepared a J32B Lansen from which *Flight* photographer Michael Barnes was able to take the accompanying air-to-air photographs. The aerobatic team, incidentally, was that newly chosen by the RSAF from the Third Squadron of F-16 Wing to represent it next year at national and international displays.

Most of the information which follows is based on the Sk35C, but I have tried to relate it as much as possible to the significance of subsequent modifications.

In basic systems the Sk35C is a remarkably simple aeroplane, especially so in view of its Mach 1.5 capability and its ability to operate from quite short and very narrow runways. Obviously, the



Slanting rays of the northern winter sun and the reflections from the photographic Lansen's canopy accentuate the bizarre silhouette of the Draken's double-delta wing

SAAB DRAKEN in the Air . . .

Pilot and attendant groundcrew illustrate the Draken's compactness. The man at left is detaching the refuelling hose from the socket in the starboard wheel-well. Main undercarriage legs are splayed outwards

sharply swept double delta plan-form with elevon control surfaces is a major feature, particularly in an aircraft used for training relatively inexperienced pilots. The potential handling problems are considerable, and appear even more so when one first hears about the potentialities of "back of the drag curve" flying, super stall and a completely linear control-gearing and spring-feel system. The three-axis autostabilization loops of the Lear autopilot are used all the time, although the aircraft can be flown "raw." Instructors joke of the pitch oscillations induced by pilots unaccustomed to the type, and it is not unknown for such oscillations to become sufficiently severe to slightly injure the pilots, but this can easily be avoided by letting go of the stick and allowing the autostabilizer to damp the aircraft. All J35As and subsequent versions now have a non-linear feel spring which increases stick force near the centre point, leaving a relatively low force at the larger deflections used in supersonic flight. Draken controls are in any case optimized for supersonic flight, and the aircraft is not unnecessarily difficult for pilots accustomed to modern interceptors.

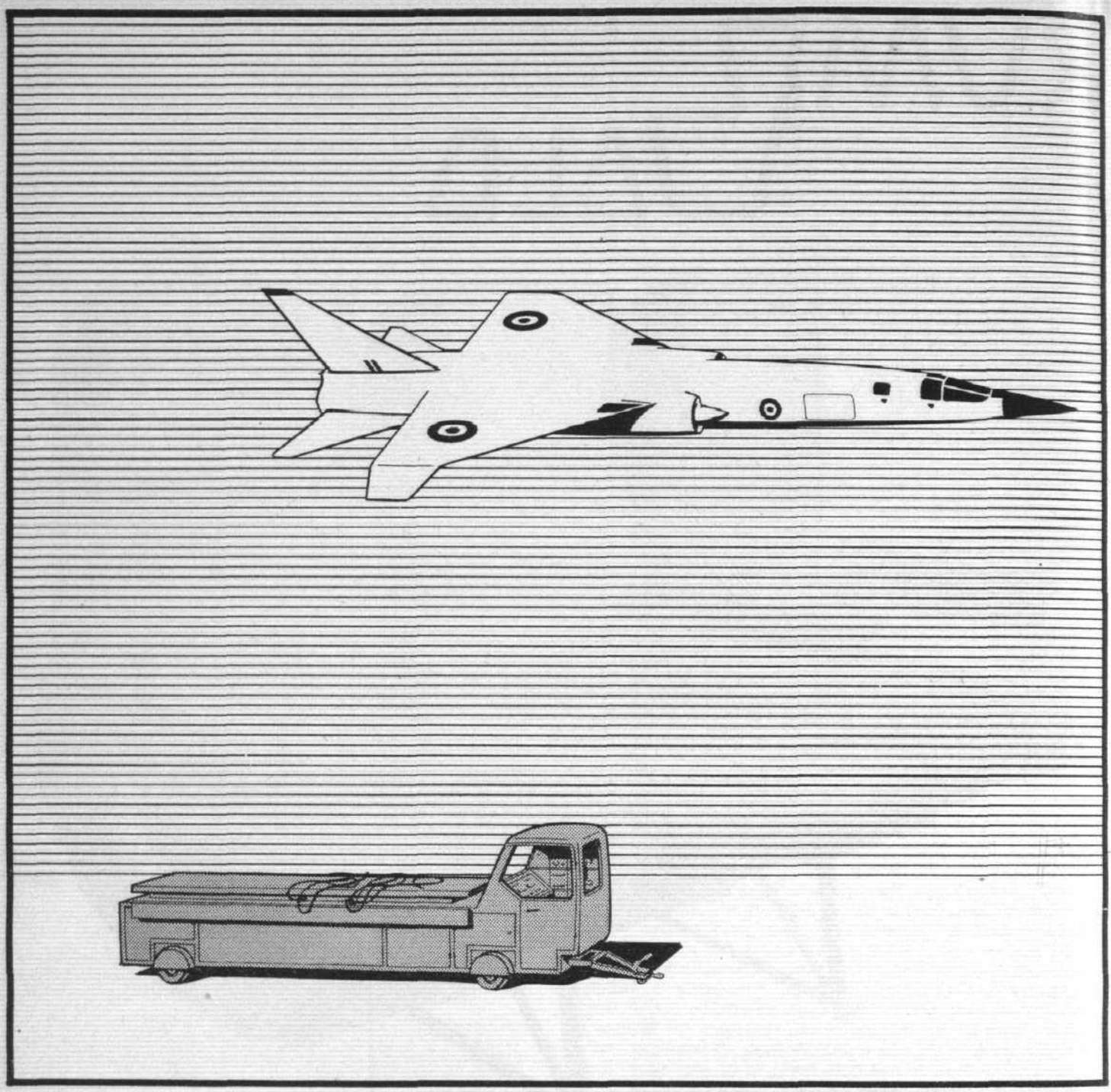
Although the Draken has ample stall warning in the form of high-frequency buffet at high speeds and a tell-tale lateral wobble at low speeds it is possible, if either symptom is ignored, to enter a super stall condition during which the aircraft may perform any evolution from a stable nose-up descent to compound pitching and rolling at up to 2½g. The super stall has been investigated in all flight conditions by Saab test pilots and the recovery technique is to apply full forward stick as the nose pitches down, to rock the aircraft into a steep dive. Although well understood, the super stall will not be demonstrated during training until the new explosively ejected tail parachute is fitted to the Sk35C. At present, an average of four or five pilots in each Wing have experienced and recovered from the condition. During my two sessions in the simulator, without the physical sensations of actual flight, I inadvertently entered four or five super stalls in various attitudes, but I found that the actual aircraft with its perfectly distinct g and buffet background was altogether less sensitive.

Continued on page 105

RUMBOLD

After extended evaluation Central African Airways have now chosen the Rumbold seat for their fleet of B.A.C. One-Eleven aircraft. Aer Lingus Irish International Airlines have also chosen Rumbold seats for their fleet of One-Eleven aircraft.

L. A. RUMBOLD & CO. LTD. WILLESDEN, LONDON, N.W.10



CHECKMATES

Britain's TSR-2 will only have short warning of an impending sortie—but essential pre-flight testing by manual methods on this very sophisticated aircraft can take many hours. The only way to meet the requirement for rapid operational readiness is by reducing between flight inspection time through the use of automatic test equipment.

The Hawker Siddeley Dynamics T.R.A.C.E.*, working with superhuman speed and accuracy, will ensure the high degree of readiness required from the TSR-2. The rugged, mobile equipment will check electronic systems installed in the aircraft automatically under world-wide service conditions.

In military or civil use, T.R.A.C.E. saves time, reduces spares holdings and maintenance costs—either in hangar workshops, on flight aprons or at forward air strips.

* *Tape-controlled Recording Automatic Checkout Equipment.*

HAWKER SIDDELEY DYNAMICS LTD

Hawker Siddeley Dynamics Ltd., Hatfield, Herts., Hatfield 2300, manufacturers of missiles, rockets, a wide range of components and aerospace equipment. Other Hawker Siddeley Companies supply civil airliners, civil and military transports, military strike aircraft, military trainers, business aircraft, transformers, switchgear, alternators, and other heavy electrical plant, locomotives, marine and industrial diesel engines from 1·5 to 7,500 B.H.P., transport refrigeration units, land, sea and air navigation systems, light alloy products, sewage treatment plant, agricultural equipment, and light and heavy general engineering products.

The Sk35C trainer cockpit shows the distinctively sharply raked ejection seats, inner blast screen recessed to take the periscope mounted in the black centre canopy panel, the access ladder and the extended ram-air turbine aft of the nosewheel leg. The Sk35C carries neither radar nor missiles

SAAB DRAKEN in the Air . . .

An outstanding feature of Draken operation has been the use of extremely low approach speeds well up the back of the drag curve, a procedure requiring delicate and constant management of throttle and careful control of angle of attack. Now, following a number of undershoot incidents, approach speeds have been slightly increased and the target touch-down speed is equivalent to 140kt, with experienced pilots closing the throttle as they cross the runway threshold.

The a.s.i. of all Drakens has a white band extending downwards from a speed at which the angle of attack is sufficient to touch the tail on the runway. In the Sk35C the band starts at 260km/hr (140kt) though some pilots say they can touch down safely at 240km/hr (130kt). Trainees are taught to set up the appropriate angle of attack early—by eye, because there is no angle of attack indicator—and to drive the aeroplane on to the runway without flaring or reducing power.

Basic systems of the Sk35C are straightforward and conventional. Groups of integral and bag tanks in the fuselage and inner wings are supplemented by additional tanks replacing the two 30mm Aden guns. Fuel tankage is divided into front and rear groups whose contents are individually shown on a two-needle gauge marked in percentages. Transfer is automatic. Target fuel contents for landing is 20 per cent, but a go-around is feasible with 10 per cent.

Electrical power is provided by d.c. generator and constant-speed alternator, with a ram-air turbine-driven generator for emergency power in most later Drakens. Otherwise the aircraft battery has sufficient capacity to maintain vital loads during an engine-out approach. Hydraulic power is by conventional two-pump, two-circuit system operating powered controls, airbrakes, undercarriage, wheelbrakes and nosewheel steering. The last-named is controlled by a tiller wheel on the right-hand console and the brakes are applied by toe pedals. The ram-air turbine also drives a hydraulic pump.

Engine handling is, in Rolls-Royce tradition, very straightforward. For starting, low-pressure cocks for engine and afterburner are opened by switches, the battery is switched on, the throttle moved out of the h.p. cock gate and the starter button pressed for 2sec to initiate the i.p.n. starter turbine. After being switched on at 27 per cent r.p.m., the generator can handle normal loads, but it is standard practice for a ground generator driven from the front of the standard ground-support truck to be coupled to the aircraft for as long as necessary to ensure that the radar is functioning in a stand-by condition and the instrument gyros are spun-up ready for instant getaway.

Full cold thrust is reached at 100 per cent r.p.m., after which the throttle can be pushed through a detent to light the afterburner. A 9 per cent r.p.m. range is then available to vary thrust for formation flying. The 100 per cent cold power can be restored by extinguishing the afterburner with a switch just within reach of the left finger tips when the throttle lever is in the afterburner range. The engine can be throttled right back at any Mach number and the afterburner can be lit at any speed. An automatic j.p.t. limiting system is disengaged whenever the nosewheel is extended to prevent inadvertent loss of take-off power.

The rear cockpit of the Sk35C is equipped only with minimum instrumentation, including a conventional electric artificial horizon, combined Machmeter/a.s.i. and other basic dials. Virtually all switches, systems, and navigation equipment, undercarriage and drag-chute are controlled exclusively from the front cockpit. The rear pilot has little more than throttle, stick, pedals, brakes and canopy jettison. Background colour is green and night lighting is very effectively provided by red bulbs behind a metal screen at least ½in clear of the main instrument panels. The cutouts through which the dials are viewed are carefully angled to allow for parallax and avoid unwanted cut-off. In the J35A simulator this form of lighting proved extremely effective. The RSAF is possibly one of the two Air Forces in Europe still to use metric measurements for flight instrumentation. (Is there, I wondered, a kilometre Centigrade, according to which one Megameter would always equal Mach 1. For once, the metric system has not tied everything neatly together.)

If the rear cockpit of the Sk35C is stark, that of the J35A is hardly complicated. Dominant central positions are taken by the weapon sight and the interception radar scope. Flight instruments are traditional except for the metric measurements, but a v.s.i. is conspicuously absent. The altimeter has zero at the bottom of the dial and no third needle to indicate above 10,000m. This appears extraordinary to one used to altimeters in feet, but the difference between 32,800ft (10,000m) and zero is a great deal more readily sensed by a.s.i., Machmeter and other indications than 10,000ft. Nevertheless, some pilots have misread it.

The simulator has a perfectly plain gyro-magnetic compass with fixed dial face and rotating indicator needle, a layout demanding inverted thinking when flying in a southerly direction. Much more advanced is the use of a Swedish ASA twin-gyro reference with a Sperry globe horizon combined with Sperry Zero Reader.

SAAB DRAKEN in the Air . . .

This forms an all-attitude reference on which one can fly a loop. The Zero Reader can be coupled to weapon and approach modes.

Communications radio consists simply of a Swedish FR14 VHF set on which 28 frequencies can be preselected. The chosen 28 can be changed by rearranging a simple patch-board rapidly extracted from the face of the control panel. Stand-by VHF is a pair of small Collins 90/190-channel commercial units. Standard Swedish tactical navigation aid is DME, probably of the 200Mc/s type, from which the RSAF has derived an unusual precision approach system. To the normal 300km, 30km and data link modes has been added a precision approach mode in which the beacon transmits a $\pm 3°$ localizer beam along the runway, to be followed with the DME left/right needle. The glide-path is formed by range computed with barometric altitude sensed from a special pitot head on the fin and referenced by a separate pressure-setting veeder counter. The DME beacons are sited appropriately to instrument runways and the distance indications are factored for the length of runway between beacon and approach threshold. With this system, Draken pilots achieve weather minima of 100m and 2km (about 300ft and one mile). GCA is also extensively available.

The fire-control radar is controlled from four press-buttons mounted on the throttle lever, leaving the right hand either for the stick in manual flight or for the controller of the Lear autopilot on the right console. Three-axis stabilization is ready for use about a minute after switching on. The pilot can command bank angle for a turn, and pitch attitude, but there are no holding or following modes in the J35A.

Central warning panel and attention-getting light are conventional. Air conditioning seems to be good, with an emphasis on heating, as one might expect in northern climates. Pressurization begins automatically at 4,000m (12,200ft) and rises to a maximum differential of 0.23kg/sq cm (3.3lb/sq in). It operated extremely smoothly in the Sk35C, causing no ear-popping even during a series of roaring half rolls and pull-throughs.

Like the Sk35C, the J35A has a conventional Saab ejection seat inclined at an unusually steep angle rearwards, so that the pilot leans well back in flight. A g-suit is standard in all Swedish jet aircraft and has even been fitted to Swedish Vampires. The pilot wears a special lightweight kapok inner jacket, g-suit, knee-length zipped leather boots bearing leg-restraint attachments, lightweight flying suit containing an assortment of emergency equipment and an American Mae West. The back-type parachute with dinghy pack permanently attached below it is quite a weight to carry around and bears a dinghy "dog-lead" to be attached to the Mae West and the "cake-maker," so called because, if you get out without undoing it you deploy the parachute and have to buy a cake for the chaps. Headgear is conventional "bone-dome" and earphone set combined with a civilized version of the dreadful A13A oxygen mask.

The J35D David introduces an important series of modifications to the systems described above. The radar is quite different and vertical tape instruments are tied-in with the data link system. The autopilot is the more advanced Saab FH5 with air data system, stick-steering, and various following modes. The new Saab/G.Q. ejection seat and parachute system, in which the parachute remains in the aircraft, is combined with a new integral suit containing g-suit and Mae West. Life is generally easier for the pilot and the equipment a great deal more effective. The relative simplicity of the J35A must be viewed strictly in this light.

Final performance details filled in before my first flight in the Sk35 was that the limiting i.a.s. was 1,180km/hr (638kt) and that the normal peacetime climb for noise-abatement purposes, was 850km/hr (460kt) to 4,000m and thence at a constant Mach number in the region of 0.9. Normal descent is made clean with the throttle closed. The airbrakes are rarely used. Dead-stick landings are perfectly feasible and squadron pilots practise them once a month. I watched an instructor make a dead-stick practise approach in the J35A simulator. Drag parachute and arrester barriers on nearly every runway must considerably improve the prospects in an actual dead-stick landing.

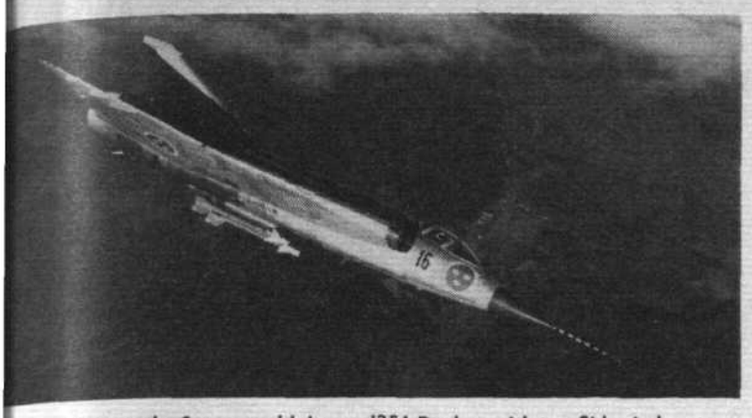
The F-16 Wing had scheduled two flights for me, though they planned the typically rapid turn-round between flights. I had briefed and familiarized with one pilot, but three days of fog brought him into an off-duty period and I actually made the flights with Capt Rolf Ericson, commander of the Draken conversion squadron. As endurance was strictly limited when using the afterburner, we planned simply to demonstrate a reheat climb, acceleration to supersonic speed, several of those horrifying pull-throughs and a descent and landing. Ericson did most of the flying for the first flight while I concentrated on taking notes on a plastic knee-pad. Strapping-in involved a stiff climb with the parachute and dinghy pack, on to the forward delta and along to the rear cockpit, taking care not to lean on the sideways opening canopy and acknowledging a warning shout before the electric closing motor was actuated. The kit was quite comfortable for the first flight, but the emergency oxygen bottle refused to budge from the base of my spine for the second flight and would have made an ejection extremely unpleasant. This used to happen in the Meteor.

I had time to note that the oxygen-flow tell-tale was tucked away on the right console, completely out of the line of sight and to try the effect of the three rear-view mirrors fitted in day-fighter tradition. The rear side window afforded a good view of most of the wing—a rarity nowadays.

Before the twin-lens periscope was fitted, the view for landing was very bad because of aircraft attitude and strong reflections on the inside of the canopy. Early instructors had had sheets laid out beside the runway threshold to guide them in during a pupil's first few landings. Though the periscope hid what natural forward view there had been it did give a fairly good artificial forward view, though range perception was difficult and head movement limited. In approach attitudes an occasional sight of the nose-mounted pitot gave some clue to aircraft attitude.

At the end of the runway we waited a few seconds for the gyros to spin up and then lined up and applied full afterburner power. Surely this is one of the most thrilling sensations to be had nowadays! Security has censored my timing of take-off acceleration and initial climb, but we made 10,000m (32,800ft) in 2min 40sec from brakes off and levelled off at 12,000m (39,400ft) and began a slight dive to reach supersonic speed more quickly. At 11,200m (36,800ft) we slipped past Mach 1 without the flicker of an instrument, with the afterburner still on and the fuel gauge visibly unwinding.

A pair of Drakens touch down at Uppsala. Glide-slope speed is under 150kt and the touch-down is made without reducing power or significantly flaring. No angle of attack indicator is fitted



Low over the forests and lakes, a J35A Draken with two Sidewinders turns towards base in the slanting northern sunlight

Then Ericson paused at 690km/hr (372kt) and Mach 1.01 and announced the first pull-through. I tensed while he rolled over, cut the afterburner with the finger-tip switch and pulled 4g into the vertical dive. We really did slow down and were level again, flying southwards at Mach 0.9 by the time we had descended to 18,700ft. While I was still congratulating my ears on not having popped and scraping the facts on to my knee-pad, Ericson zoomed to 7,000m (23,000ft) for another pull-through, this time starting at below Mach 1 but with afterburner lit. "They're all married with family responsibilities" I thought as I tensed again, watching the cloud-deck approaching the top of the canopy. My mental reply was lost in the grey-out as Ericson pulled 5g or 6g and my g-suit clamped me in a vice-like technological embrace. Yet we had gained only about 100km/hr (55kt) when we levelled off once more at about 5,000m (16,400ft). As I continued to write on my knee-pad Ericson made the final pull-through, starting at 5,000m with full cold thrust and emerging after a steady 6g pull at 3,000m (9,900ft) with only Mach 0.8, with 800km/hr (432kt) i.a.s. If I had not quite appreciated the prodigious drag of the delta wing at high angles of attack, this was certainly the most forceful demonstration possible. Even with the afterburner lit we decelerated in the pull-through, when the same power had earlier given us a rate of climb of better than 15,000ft/min.

Starting now from 2,000m (7,200ft) and Mach 0.9, Ericson showed the Draken's vertical climb. We sailed almost vertically upwards with afterburner on, to roll-off into horizontal flight at no less than 9,000m (29,600ft). The tactical usefulness of this manœuvre must be limited to escape from anti-aircraft fire or conventional AI radars, but it is certainly exhilarating.

Ericson completed the business of the first flight with some rolls and loops during which I began to get the feel of the very high frequency buzz which is the first pre-stall symptom.

Approach and Landing

After a censored time airborne and fuel consumed, it was now time to return to base and, using DME range and ground radar Ericson descended at 550 to 600km/hr (296-323kt).

At this point I first took control, discovering that the Draken was light and very responsive at these speeds. Several times I opened the diminutive airbrakes but could trace no effect at all. Swedish pilots hardly ever use them. Ericson made the run-in under fairly low cloud, using one brief application of g to reduce speed and lower the undercarriage on the downwind leg. He flew a descending curved base leg and approximately 1,000yd straight-in final holding about 80 per cent r.p.m. and perhaps 10° angle of attack. As we crossed the threshold, Ericson closed the throttle and touched down with no perceptible flare. He then streamed the drag chute and we decelerated hard with the aircraft rocking from side to side on its narrow-track undercarriage as a cross-wind caught the 'chute. In this condition the Draken felt very much like a Gnat trainer.

Though reflections on the inside of the canopy severely limited visibility forwards during the final approach the periscope gave a reasonably good view of the runway, with the nose boom providing a slight reference mark. Although the periscope would not greatly help a beginner in landing, it is adequate for an experienced instructor.

Pausing just long enough to copy my knee-pad notes and smoke a cigarette, Ericson and I returned to the same aircraft for the second flight. We decided this time not to use the afterburner and that I should fly as much as possible. Again, take-off performance was censored, but I took over for the climb at 850km/hr (458kt), and held Mach 0.88 from approximately 6,000m (19,700ft) onwards. First experience of flying at fairly high i.a.s. showed the Draken to be very sensitive longitudinally and quite easy to push into rapid pitch oscillations, despite the autostabilizer. But I had sufficient powered control experience, especially in helicopters, to settle down quickly and found the speed quite easy to hold. Lateral and longitudinal controls were very pleasantly co-ordinated—qualitatively between the heavy elevator/light aileron combination of the Mirage III and the silky perfection of the Lightning. The electric stick-top trimmer operated slowly and with some delay, but was quite conventional. I levelled off at 10,000m (32,800ft) and throttled back to cruise at Mach 0.9 to the over-sea supersonic area. Once there, I dived gently at 100 per cent cold thrust. At Mach 0.93 there was a distinct nose-down trim change, but no further symptom emerged up to Mach 1.01. During the rather prolonged dive to this Mach number the Draken really showed its best handling. It is indeed optimized for transonic and supersonic flight and becomes an extremely pleasant handling aeroplane, without any tendency to over-sensitivity. During a turn at 7,000m (22,900ft) the Machmeter immediately dropped below 1.0 and very high frequency buzz gave an absolutely distinct warning of high angle of attack. It was rather disappointing not to have some quantitative indication like that in the Mirage. At between 600 and 700km/hr (323 and 377kt) I made a succession of slow, rapid and four-point rolls, during the last of which I was beginning to get the knack of hesitating without actually reversing the direction of roll. Aileron control was sufficiently sensitive to require a little practise.

Low-speed Handling

Next objective was slow-speed flying, for which I throttled back and slowed down to 260km/hr (140kt). Minimum drag speed and the fairly steep drag rise were clearly evident, but the value was censored.

Having reached 140kt I began to manœuvre the Draken, but immediately felt Ericson's hand tight on the controls, blanking all subsequent feeling of the aeroplane. As we had not briefed extensively together before the flight, he was not prepared to allow me to experiment at these speeds, though in my few free seconds I did get the impression that the elevator control is extremely sensitive. I am sure that the Draken in this condition is not as difficult as these words might indicate. Ericson was simply exercising maximum caution.

Recovery from a super stall involves considerable height loss and Ericson was evidently not willing to become involved. One reason for the super stall appears to be that the less sharply swept outer wing panels stall first, inducing pitch-up. The lengthened tail being retrospectively fitted to all J35 Drakens improves longitudinal stability, but this Sk35C had the old short tail.

By now the emergency oxygen bottle was firmly pressed against the base of my spine and I suggested a return to base and one overshoot before the final landing. Ericson again descended below cloud and flew southwards to Uppsala at 500m (1,640ft) and 600km/hr (323kt). This time I closely watched his landing technique. He slowed down to 500km/hr (269kt) by pulling some g, lowered the gear and throttled right back to 45 per cent to reduce speed to 300km/hr (162kt) at the end of the down-wind leg. He then applied quite a lot of power for the base leg turn and came most of the way down to the runway at 300km/hr, again chopping the throttle a second before an unflared touch-down. The RSAF has not allowed me to record the actual speed. Without the drag chute, the Draken ran straight on the runway without any snaking or lurching. Aerodynamic braking is usually used to the full and the tailwheel, where fitted, is kept on the ground until elevator effectiveness is lost.

Although I had intended to do so, I was not able to fly the Draken with the autostabilizer switched off, but a Swedish test pilot reported that pitch-axis damping following sharp tapping of the stick was not greatly different in the unstabilized condition.

The Draken is certainly a stimulating aircraft and one which still has a very considerable future. It is remarkable that the RSAF has now successfully introduced a conversion training scheme for pilots with as little as 160hr experience. The details of this programme are recorded in the Defence section of this issue on page 120.

The HS.125 ordered by the Directorate of Civil Aviation of Australia during a pre-delivery test flight from Hatfield. It will be used for crew checks and radio aid calibration. HS.125 production commitment has been increased from 90 to 110

SPORT AND BUSINESS

North American have Increased their Warranty for the Sabreliner from the customary 12 months to 24 months and from 1,000hr to 1,500hr. Twelve-month warranties already issued will be retrospectively doubled. The t.b.o. of the P&W JT12A turbojets has been increased from 800hr to 1,300hr; and NAA have offered free of charge modifications permitting a take-off weight increase from 17,760lb to 18,650lb.

Engineering Improvements and a $20,000 price increase have been announced for the Lear Jet. Total flight time early this month was 1,200hr in eight aircraft and one demonstrator was being intensively flown at up to 150hr per month. The changes include a redesigned instrument panel for one- or two-pilot operation, GE CJ610-4 engines 20lb lighter than the original CJ610-1s with no change in performance, weight savings of no less than 30lb in the weather radar and 15lb in the ADF, an improved braking system, doubly thick soundproofing, cabin lights, even-flow heat distribution, fast-acting demisting system, and all-metal wing leading-edges. The new price represents an increase of 3 per cent and now stands at $595,000 completely equipped and furnished.

A Musketeer 2 and a Bonanza S have now been delivered by Short Brothers & Harland Ltd, the UK distributors, to customers in Britain. The Musketeer 2, powered by a 165 h.p. Continental IO-346 and bought by Vertex Optical Company and Cindico (Great Britain) is based at Driffield, Yorks. In addition to standard Beech Navateer radio this aircraft has King com/nav and marker receiver, Bendix T-12B ADF and blind-flying instruments. Cindico's managing director, Mr R. H. Downs, is flying the Musketeer for both companies in connection with export business. He flew 250hr last year in an earlier Musketeer to places as far afield as Corsica and Stockholm.

The Bonanza S, powered by a 285 h.p. Continental IO-520 was flown from Wichita via Bermuda, the Azores and Lisbon, covering the 2,270-mile Bermuda - Azores leg in 12hr 45min.

ARB Class 1 Approval was granted to the new King Radio Silver Crown com/nav radio series after only 14 days' investigation, largely because the American company expressly followed ARB requirements at the design stage. Class 1 in Britain is automatically accepted at the same level in Holland and Scandinavian countries. The new KX-160 series units were described in these columns on November 26.

The KX-160 com/nav unit with KI-211 cross-pointer indicator and 20-channel glide-slope built-in to the indicator now costs £865 in Britain and is thus almost exactly £200 cheaper than the next equivalent American unit. It is also remarkable that the KX-160 by itself, operating as a 360-channel com set, but including the receiver portion of the nav element, is some £10 cheaper than the KY-95E plain 360-channel com set. It is thus logical to instal the basic nav capability as part of the initial step to 360-channel com, leaving the way open to subsequent addition of the nav indicator. A great attraction of the new King equipment is that all units including the power pack form part of the main cases, leaving no remote installation and little interconnecting wiring to instal.

King are also introducing a new KMA-12 audio control panel with isolation amplifier, marker receiver and lamps, together with a remarkably compact ADF in which both the controls and indicator are on a single dial-sized unit, rather than in the conventional oblong control panel and separate indicator dial. Joint UK distributors for King Radio are C.S.E. Aviation Ltd at Oxford Airport and Airwork Services Ltd at Hurn.

A Six-week Agricultural Flying Course is being arranged by the International Agricultural Aviation Centre at The Hague and will first be held during October and November at Cranfield. Pilots must have a CPL or equivalent experience and will have 50hr of flight training and lectures on chemicals, agricultural laws and botanical matters. Cost will be £550. The first course will be for 12 or so pilots, but subsequent annual courses may be larger. Full details may be had from I.A.A.C., le v.d. Boschstraat 4, The Hague, Netherlands.

Glued Joints: Swedish Decision The deterioration of glued joints in older aircraft of wooden construction has for some years been a matter of concern to airworthiness authorities in many countries and, following two accidents which were directly attributable to this, the Swedish Directorate of Civil Aviation has now forbidden the use of sailplanes built before 1946. Those built between 1946 and 1950 are to be carefully inspected before being allowed to continue flying, and they can be used only for five more years. This means that practically all Grunau Babies, all Weihes and most Olympia 2s on the Swedish register have been withdrawn from use. The decision will have further far-reaching effects, for in recent years secondhand wooden sailplanes have been exported from Sweden to many foreign countries, including Britain, Denmark, New Zealand, Norway, and the USA.

New Finnish Sailplane Illustrated on page 109 is the KK-1b Utu sailplane, a new all-plastics machine (glass-reinforced plastics and polyurethane foam) designed by a group of engineers at a Helsinki firm, OY Fibera AB, to meet OSTIV standard-class requirements. The prototype first flew last August and the series

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3 at a time—up to 40,000 feet
Plessey-UK static inverters have been designed to handle the varying power factors of mains electric razors. More than 19 different types have been tested on Plessey-UK static inverter power supplies. These units are truly universal razor inverters, and can power three razors simultaneously. Among the many airlines using these inverters are BOAC, BEA, BUA, and TAA.
Weighing only 4 lbs. 5 ozs. the Plessey-UK 40VA razor inverter converts normal aircraft d.c. supplies to 110 or 220 V a.c., 50 c/s single-phase, and is suitable for altitudes up to 40,000 feet and temperatures from −20°C to +45°C.
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SEAT AND AIRCRAFT

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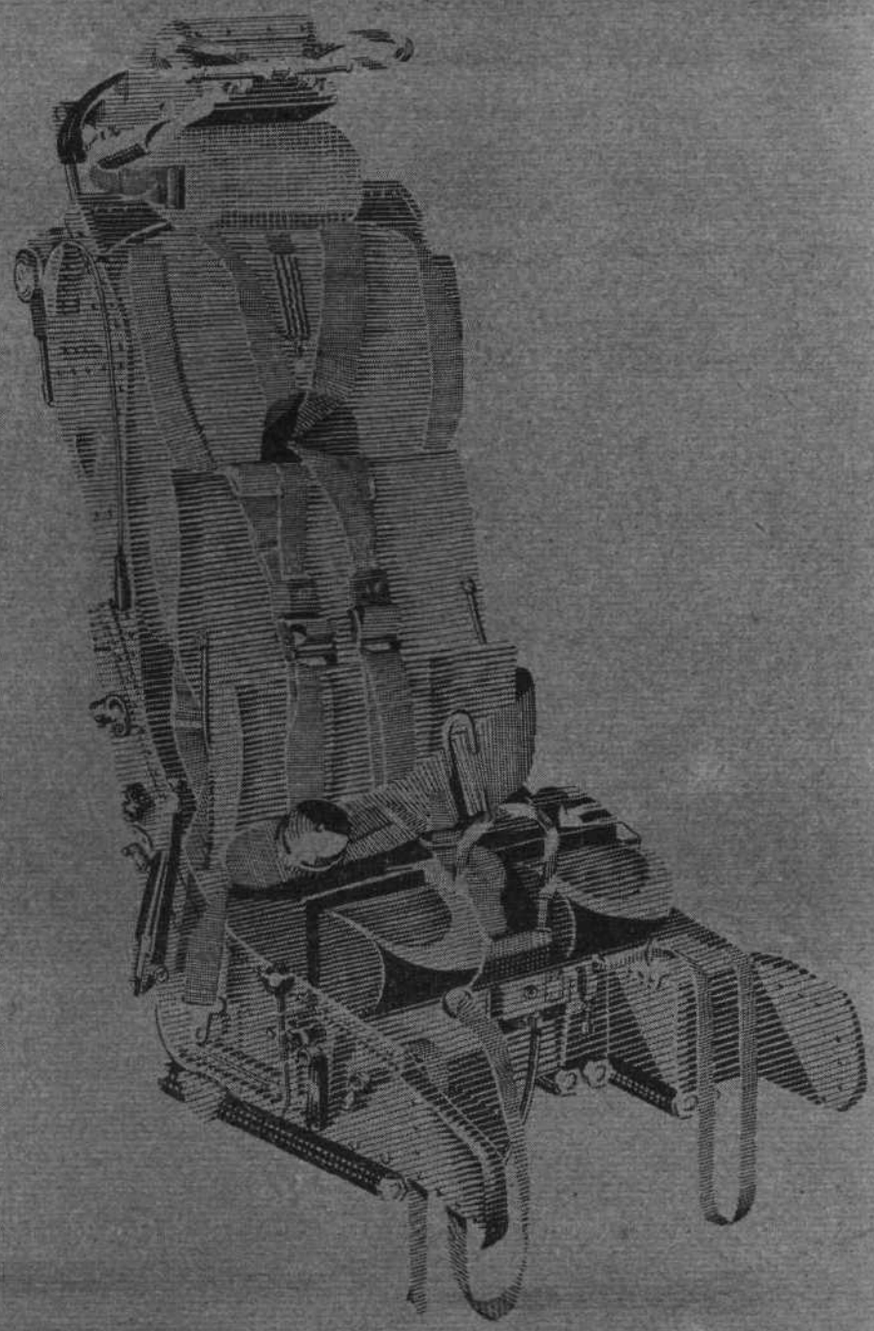
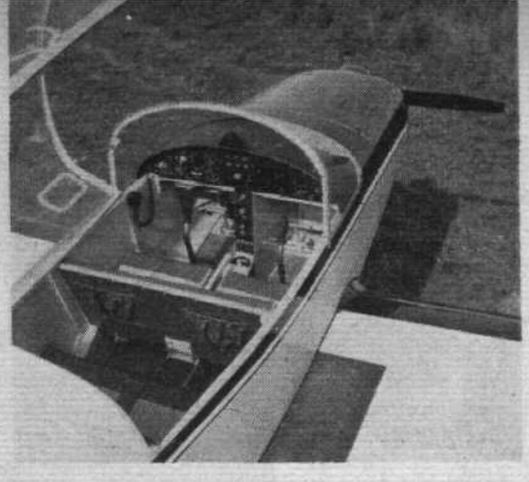


Fitted in the Hawker Siddeley Kestrel, the Mk. 6HA rocket assisted ejection seat is one of the latest range of Martin-Baker seats capable of bringing about safe escape from a zero-speed/zero altitude emergency. Particularly valuable for VTOL operation, these seats are installed in the EWR.VJ-101C, Mirage 3V and are under evaluation for several other types of aircraft.

MARTIN-BAKER

Aircraft Co. Ltd. Higher Denham Nr. Uxbridge Middlesex



Now being produced by Uetz at Fehraltorf, Switzerland, is the U4M Pelikan, which received its Swiss C of A last June. Salient details are: span, 31ft 7in; length, 24ft 7in; wing area, 142 sq ft; empty weight, 1,132lb; gross weight, 2,200lb; engine, 150 h.p. Lycoming O-320; max speed, 135 m.p.h.; cruising speed, 123 m.p.h.; stalling speed, 41 m.p.h.; rate of climb, 700ft/min; take-off run, 740ft; service ceiling, 14,600ft; range, 620 miles; price in Switzerland, SFr 45,000 (about £3,720)

SPORT AND BUSINESS

version, identical in appearance, should be ready next month.

Aerodynamically the Utu is conventional, the designers' main purpose having been to test the structural applications of GRP laminates stabilized with foam plastics. The wing is a two-box GRP shell, with the stabilizing foam accounting for some 50 per cent of the interior volume of the wing. No ribs are used. Both wings have been made in two halves, upper and lower, using vacuum moulding and foamed as a one-shot operation. The fuselage, incorporating the vertical tail as an integral part, is a double GRP shell with a foam plastic core having an average thickness of 1.5cm.

Main data include: span, 15m; aspect ratio, 1 : 20; dihedral, 2°; length, 6.5m; empty weight, 167kg (wing 110kg, fuselage 51kg, tailplane and elevator 6kg); equipped weight, 190kg; maximum flying weight, 300kg; maximum wing loading, 26.7kg/sq m.

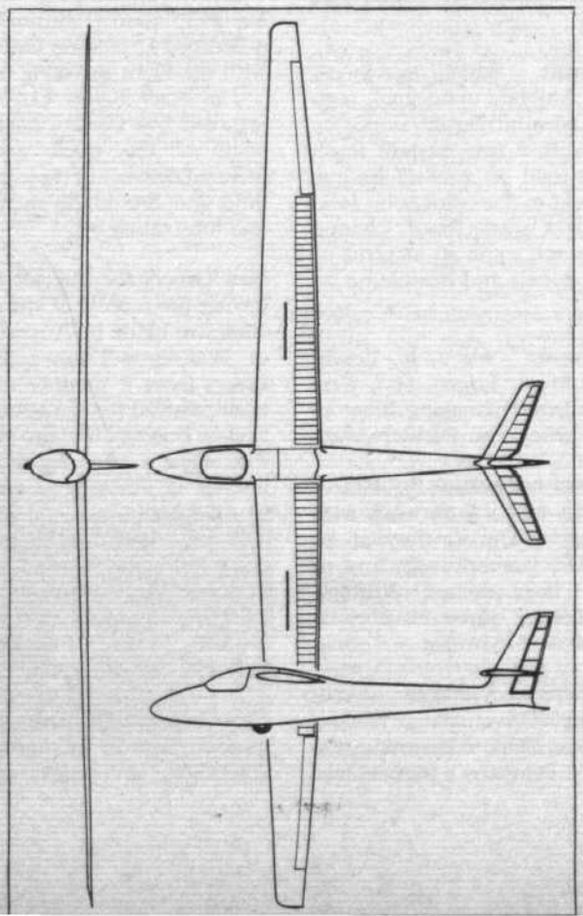
New Australian Sailplane Edmund Schneider Ltd of South Australia has announced details of the company's latest sailplane, the 15-metre ES-60 Boomerang. Designed by Harry Schneider, the machine is based on the 13-metre Arrow which was flown at the 1963 World Gliding Championships. It is hoped that at least one Boomerang will participate in this year's world contest.

The wing profiles used are the FX series of sections developed by Wortmann. Special techniques have been developed, the company reports, to ensure an accurate and stable wing surface which will be relatively inexpensive and easy to repair. The wing is constructed on an accurate steel-tube jig. The main spar is of "improved wood" with normal truss spruce ribs machined against templates to an accurate profile. The 2.5mm five-ply skin extends behind the main spar to approximately 60 per cent of the wing chord, while the leading-edge is moulded from a lightweight and stable plastic.

A feature of the Boomerang is the all-flying, high-aspect-ratio swept tailplane. This offers reductions in tailplane drag at high speeds, the sweepback being used to increase the tail moment and improve stable flight characteristics with a normal fuselage length. Two versions are planned, one with a skid and wheel and the second having a single forward wheel only. Pushrod controls are used throughout, with the exception of cables to the rudder, wheel brake and release.

The Finnish KK-1b Utu

Australian Schneider Boomerang (see news item)



INDUSTRY International

Products

Company News

Great Britain

Plessey Take Microturbo Licence An agreement was recently concluded between Plessey-UK Ltd and Société Microturbo, of Toulouse, whereby Plessey-UK will manufacture and market the advanced range of Microturbo-developed gas-turbine starting systems. Plessey will immediately have manufacturing and marketing rights for most of the world, excluding France, USA and some Far Eastern countries.

Microturbo has been engaged for several years in the development of a range of gas-turbine starting systems based on the Noelle 60 gas-turbine unit. It claims to be the only firm in the world, outside the USSR, having such equipment in quantity production. More than 500 units are at present in service with l'Armée de l'Air and are scheduled for use in RAAF and Swiss Air Force Mirage IIIs.

New developments include starting units and small gas-turbine engines, subjected to extensive tests in Britain, USA, Sweden and Germany. In addition a variety of engines have been experimentally started either on test-beds or in aircraft, including the BS Pegasus, RR Conway, the Swedish-built P&W JT8D, and also the German-built GE J79.

Manufacture under this licence and new development work will be at the Aircraft Mechanical Division of Plessey-UK, Titchfield, Hants.

Earlier, the Microturbo Noelle 60 was promoted in Britain by Teddington Aircraft Controls.

Approved for Aircraft Widely used by car manufacturers, "Ambla" upholstery material has recently been further developed by ICI (Hyde) Ltd with a fire-resistant finish so that it can be used on aircraft seating. Stocks are now held in five colours by John Cox & Son Ltd, of Carlisle Road, London NW9, who also stock some 30 patterns of Vynide for seats, panels and headlining on ARB release.

Godfrey Appointments Mr J. R. Leach, BSc, AFRAeS, and Mr J. Logan, FCA, were appointed joint assistant managing directors of Sir George Godfrey and Partners early this month.

Mr Leach's duties will include the control of the general sales and liaison work with the aircraft industry. During the war he served at the RAE, Farnborough, and in the RAF and later joined Vickers-Armstrongs (Aircraft), where he became flight test manager at Weybridge.

Seating Developments at Southend Early reports reaching Aviation Traders (Engineering) from BUA concerning the performance of the company's tourist-class seats installed in the airline's VC10s show that these have been well received by passengers and are attaining a high standard of reliability. The makers have recently designed Caravelle and Britannia versions of this lightweight seat, and negotiations with possible customers are now in hand.

A first-class double seat, complementary to the tourist-class seat, is already installed in the BUA VC10s and is going into the same airline's BAC One-Elevens. A 707 version has also been designed. This seat has both seat-back and plug-in tables supplied as standard and reclines through 40°. For easy seat-pitch variations *en route*, to meet fluctuating traffic levels, a recline restrictor is built in, to decrease this range if necessary. The seats are supplied complete with all fittings, in which state the One-Eleven version weighs 70lb (double unit) and the VC10 and 707 models 85lb.

Cabin-service Aid Recently introduced by Hickman (Aircraft) Ltd, of North Circular Road, London NW2, under the name of Mobile Airlarda is a cabin-service trolley which, designed for BOAC's VC10 requirements, shows a considerable advance on the conventional open-shelf type. Of compact dimensions for easy movement along aisles, it has its shelves enclosed in a plastic-faced casing, though easily reached by means of a door which can be folded back flat. A quickly detachable tray forms the top shelf, and a choice of plastic facings is available to suit cabin décor.

Speeding Pre-flight Checks at Heathrow Castrol equipment has been put to a novel use at London (Heathrow) Airport, where a Bedford J1 pick-up has been fitted to deal with pre-flight servicing of BEA aircraft.

The Steel Barrel Co, of Uxbridge, has installed five Castrol hose-reel units in the back of the truck and these provide metered delivery of three grades of hydraulic fluid and one grade each of de-icing fluid and lubricating oil.

New Orders for Aircraft Furnishing Following the success of the series 500 tourist-class seat made by Aircraft Furnishing Ltd, of Walton-on-Thames, in BOAC VC10s, orders from a number of customers have been received for the same type for installation in Boeing 707s and BAC One-Elevens. The makers also report that considerable interest in this type of seat is being shown by US operators.

A new departure by the company is its entry into the executive-aircraft seating business. Orders have recently been placed with the company for equipment to be installed in F.27 Friendship and HS.125 business transports.

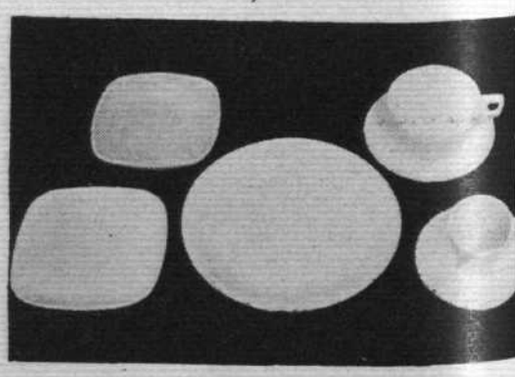
New Galley Equipment Shortly to be put into production by Aerogalley Ltd is the Heatstack, an article of airliner galley equipment consisting essentially of a stack of electrically heated (24/28V d.c. or 112/118V) drawers, each capable of holding four individual meals in foil containers. Its principal application is to thaw out and finish cooking deep-frozen food, but it is very flexible in operation and can be used for the cooking of, say, bacon and eggs, or even for toasting bread.

The height of the stack can be varied to meet each operators' requirements, the drawers can be removed for ease of loading, and deep-frozen food can be kept in a drawer for long periods simply by adding dry ice to the top container. Each drawer may be switched on or off independently.

Two other new items of equipment announced by Aerogalley—whose HQ are at Gatwick House, Horley, Surrey—are (a) the Cedar range of melamine plastic plates, dishes, cups and saucers and (b) the Aerobox. The former—of good design, as is apparent from the accompanying illustration—can be supplied either with a glazed finish or foil-decorated. The latter is a range of removable containers—tray carriers, bar boxes and the like—of particularly strong construction in Duralumin sheeting.

As reported in our issue of January 7, a party of Soviet aeronautical engineers recently visited Smiths Aviation Division's technical services centre at Heathrow. Seen here listening to the voice of the company's SADIE check-out system is Mr Smirnov (centre), deputy head of Ilyushin; with him are (left) Mr E. V. Beliaev of the USSR Trade Delegation in the UK and (right) Mr C. H. B. Barden, Smiths' assistant technical sales manager, flight controls and navigation

"Cedar" airliner tableware from Aerogalley Ltd (see news item above)



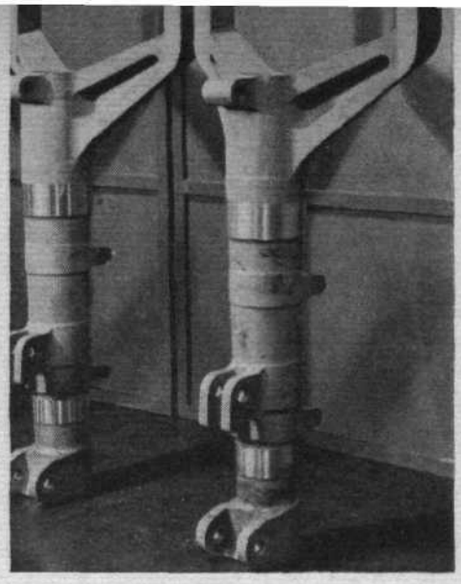
France

Planing a Runway The first stage of a programme of surface repairs on runway sections at Munich Airport has recently been completed, the work involving removal —as distinct from filling—of shallow surface-cracks. A runway extension scheme had been completed in 1961, but after the severe winters of 1961-62 and 1962-63 shallow cracks up to ⅛in wide appeared. These were caused partly by the high density of the stone-chip overlay and partly by expansion through local heating from jet engines in frosty weather.

To simplify the "planing" operations necessary to remove the cracks, contractors Karl Stöhr of Munich mounted four pneumatic hammers on a simple two-wheeled chassis and used them to chip away loose material around the cracks. A bump-cutter, supplied by the French company Société du Diamant Industriel (of Place de la Gare, La Verriere, Seine-et-Oise) followed on, its diamond cutting-blades set to a grinding depth of ⅛in to ⅛in, to restore a level surface having a finely ribbed non-skid finish.

The process, it is stated, enabled re-surfacing speeds of about 20 sq yd an hour to be achieved, while costs—including pre-roughing and cleaning—amounted to less than 25s a square yard.

Work will re-start in the spring, when any further damage occurring during the present winter will be rectified.



Several sets of undercarriages for the Dornier Do31 VTOL tactical transport have been delivered to Germany by the Dowty Group, which won the order some months ago. Before machining, an annealed high-tensile aluminium alloy forging for a main leg weighs a fat 1,427lb as it towers above the marking-off table, left, for a dimensional check. Several processes and 1,251lb of swarf later it has been reduced to a scant 176lb in the finished state

USA

The US Aerospace Industry's Sales The US aerospace industry's sales in 1964 approximately equalled those of 1963, at about $20,000m (£6,900m). Export sales, at about $1,300m (£450m), were also largely unchanged in value, although the balance of constituent parts was changed—in particular, export sales of helicopters showed an increase of 29 per cent.

Total aircraft production was an estimated 12,300, compared with slightly over 11,000 in 1963. Military aircraft output, a little over 3,000 units, was nearly double the 1963 figure, but total expenditure was $350m down, to about $6,500m. These apparently contradictory figures indicate that a large number of small, relatively cheap aircraft were delivered to the armed forces—a trend expected to continue this year, when contracts are expected to be let for the first of 6,000 US Army light observation helicopters alone. Deliveries of fighters, ASW aircraft and military transports all increased.

The commercial aircraft industry produced goods worth $3,800m, against 1963's $3,200m, and the number of turbine-powered transports built increased from 88 to about 150—many of them cargo jets. Including helicopters and general aviation aircraft, non-military aircraft sold numbered approximately 9,300.

General aviation aircraft sales showed their greatest recent growth in 1964 and the trend is expected to continue in 1965. Sales in this category were 9,200 aircraft worth $260m, against 7,569 aircraft worth $204m in 1963. Export sales of utility non-military aircraft climbed from 1,579, worth $35m, to about 1,800 worth $45m and there was a continuing demand for larger, multi-engined, heavier-payload utility aircraft.

V/STOL aircraft, other than helicopters, did not reach production in 1964 but it is expected that some $90m will be spent this year in furthering their development.

In missiles, DoD expenditure on production, evaluation, R and D declined some $700m to about $5,300m and an additional expenditure of $1,200m, the same as in 1963, was expended by DoD on astronautics. NASA's R and D expenditure in astronautics increased by $900m and was close to $4,000m.

Employment in the aerospace industry, despite declining from about 1,186,000 to 1,112,000 during the year, still made it the nation's largest employer, The proportion of production to engineering and management personnel remained the same, despite the decline, indicating that the long-term trend towards a heavier proportion of white-collar workers has apparently levelled out.

On September 30, 1964, the major companies' backlog of orders booked but unfilled was estimated to total about $15,600m, against $14,500m on the same date in 1963.

NA.300 Undercarriage Contract The Cleveland Pneumatic Tool Co has been awarded a contract by NAA's Columbus Division for development of landing-gear assemblies for the OV-10A (NA.300), a new counter-insurgency aircraft being built for the USN, whose Bureau of Naval Weapons selected North American to design, build and flight test seven prototypes. Cleveland will provide the rough-field tricycle undercarriage, which will be convertible to amphibious use by the attachment of twin floats with integral retractable wheels.

The OV-10A features twin turboprop engines and twin booms with the tailplane mounted high between twin vertical tails, on the lines of the Convair Charger, GD's private venture competitor, which is already flying and was described in last week's *Flight*.

The diamond-tooled bump-cutter, or profilemeter, in operation at Munich Airport (see "Planing a runway," above)

Kidde Back-packs for Spacemen US astronauts will be able to move in space outside their spacecraft with the introduction of a space "back pack" now being developed under contract to the Space Systems Division, USAF Systems Command. Powered by hydrogen peroxide thrusters designed and developed by Walter Kidde & Co, the pack is scheduled for use with NASA two-man Gemini missions in mid-1966. Kidde will supply components of the propulsion system under a $700,000 contract with Ling-Temco-Vought, prime contractor for the project.

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 n full. Brief letters will have a better chance of early publication.

TSR.2 Public-reaction Test?

SIR,—It is surprising, in view of the current storm over TSR.2 and the aviation industry, that little or no comment has so far come from readers in these columns.

It was said, years ago, that the Spitfire was only on the strength of the RAF because the late Lady Houston bought a squadron from Supermarines and then presented them to the Government.

In discussing the TSR.2 argument a friend suggests that the makers should float a company with shares of up to five pounds in value. The shareholders should not be permitted to sell their shares, but the proceeds should pay for one TSR.2, which the shareholders would then present to the Government. This action would at least reflect the sense of public feeling over this issue—even if the buyers were limited to the aviation and allied industries. In strategic terms, this idea would be even more valid relative to the P.1154 should this be cancelled or curtailed.

Bamford, nr Sheffield A. J. YOUNG

[*Very approximately, 460,000 shareholders at £5 each would be required to buy one TSR.2 at the price quoted on the basis of a full production run.*—Ed]

Good Service at Birmingham

SIR,—In Sensor's first column (January 7), I note with interest that Birmingham Airport is used as an example of a "value for money" airport regarding landing charges. I could not agree more, since I manage a flying school based at Birmingham and have daily cause to appreciate the excellent service and co-operation of the air traffic organization at this airport.

I would point out, however, that since Birmingham Corporation acknowledge the Royal Aero Club landing card, most private and all club aeroplanes can avail themselves of these facilities with *no charge whatsoever*.

Birmingham Airport G. T. BEDGGOOD,
Chief Flying Instructor/Manager, Mid-Fly Ltd

Parent Body

SIR,—I was not a little surprised to see in your issue of January 7, in the article "Airport Administration," the reference to the Rotorcraft Section of this Society. One would gather from this that there is no such body as the Royal Aeronautical Society as such. A casual check of the catalogue here shows some 45 items on airports in the library before the Helicopter Association of Great Britain was even formed (*circa* 1945), but the first of these (*Les premiers ports d'Aviation, c.1909*) was published 43 years after the Society was founded.

London W1 F. H. SMITH,
Librarian, The Royal Aeronautical Society

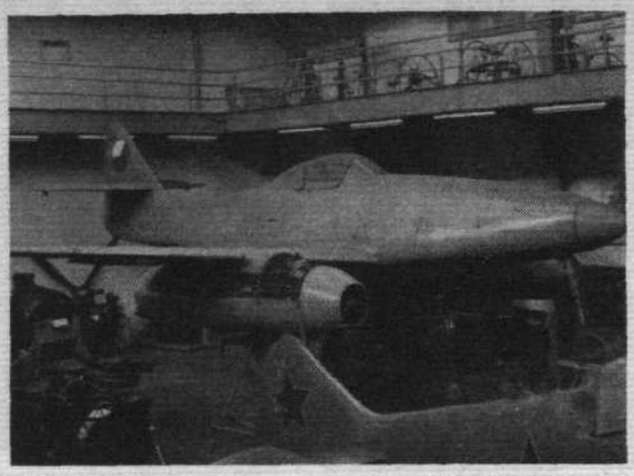
[*Incidentally, the author of the article, Mr D. E. Davinson, was named through a printer's error as Senior Lecturer, Leeds College of Technology. This should have read "Leeds College of Commerce."—Ed*]

What Constitutes Valid History?

SIR,—Referring to Mr J. Hunt's letter (January 14), I am "ignorant" of none of the "facts" he lengthily and unnecessarily expounds. I do not dispute that 10,000 or more enthusiasts in Britain may record every aircraft's every moment, and that similar hordes do the same abroad. What I do question is the usefulness of it all; I dispute that an immensely detailed record of every aircraft is of significant value in the compilation of aviation's history. Your correspondent's letter contains no word on what *use* all this unreadable garbage is.

But each to his own taste—and if Mr Hunt has all those foreign magazines to read, listing full number/registration/owner/colour details of every aircraft mentioned, I trust he will excuse you if you do not do the same in *Flight*.

Llandewi Ystradenny, Rad RHYS AP JENKINSON



Me262 in Prague Technical Museum (letter from Mr L. Hunt)

Museum Me262

SIR,—Readers may be interested to know that in the Prague Technical Museum is displayed an Me262, presumably manufactured in Czechoslovakia during World War 2. A Spitfire, alas, is no longer exhibited and is thought to be stored along with many other aircraft, in a storage hangar outside the capital. Mr Neville Franklin of Newark has kindly loaned the accompanying photograph.

Leigh-on-Sea, Essex LESLIE HUNT

DIARY

Jan 21	*RAeS Cambridge Branch: "The Wallis Autogyro," by Wg Cdr K. H. Wallis.*
Jan 22	*Society of Licensed Aircraft Engineers & Technologists: "Electronics Systems Reliability." The airlines' view: F. Hoyle; the manufacturers' view: J. Stewart.*
Jan 22	*British Interplanetary Society Western Branch: "Space Environment," by R. F. Ayers.*
Jan 22	*RAeS Belfast Branch: Annual dinner.*
Jan 23	*British Interplanetary Society Yorkshire Branch: "Planetary Radar," by Dr J. H. Thomson, Leeds.*
Jan 26	*RAeS Air Law Group: "Bilateral Agreements," by P. Jack.*
Jan 27	*Institution of Electronic and Radio Engineers Radar Group: Symposium, "Enhancement and Absorption of Radar Radiation."*
Jan 27	*RAeS Graduates' and Students' Section: "Hovercraft," by S. R. Hughes.*
Jan 27	*RAeS Brough Branch: "Design Problems of Modern Aircraft," by D. James.*
Jan 27	*RAeS Hatfield Branch: "Man in Space," by Wg Cdr Fryer.*
Jan 27	*RAeS Southampton Branch: "Accident Investigation," by G. W. Acock.*
Jan 27	*RAeS Weybridge Branch: "Future Trends in Aircraft Design," by N. W. Boorer.*
Jan 29	*RAeS Rotorcraft Section: Half-day symposium, "Powered-lift Applications in the Commonwealth," by Dr I. C. Cheeseman; and "Helicopter Trials over Sand and Sea," by W. A. Hibbert.*
Jan 29	*RAeS Preston Branch: Annual dinner and dance.*

Apollo simulator (1): a NASA engineer at Ames Research Center tests a midcourse navigation simulator for use in training astronauts in the Apollo lunar programme

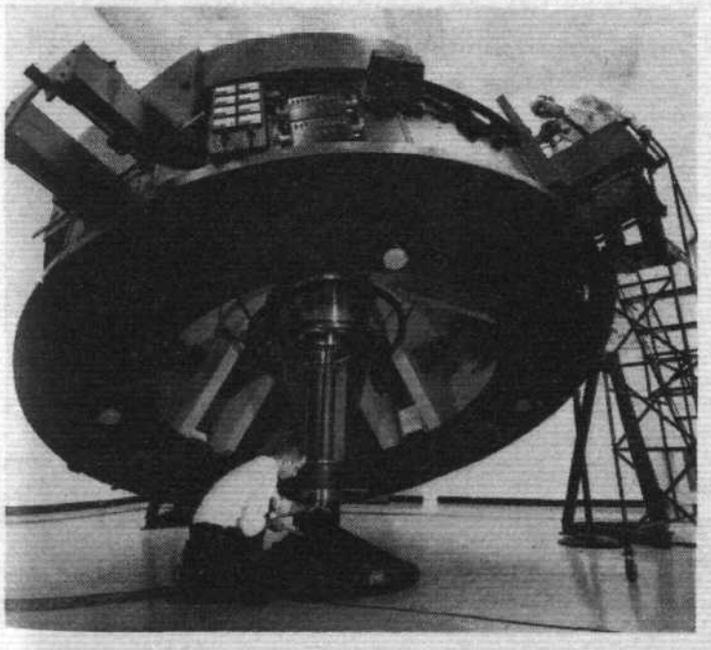
Spaceflight

USAF SPY-SATELLITE PLANS

A major new development in reconnaissance satellite techniques used by the US Air Force is now under way, according to unofficial Washington reports. At present Thor Agena and Atlas Agena vehicles are used to orbit payloads which take photographs of ground areas which might be of interest to the Department of Defense, and the capsule portions of the payload containing the exposed films are ejected from orbit and recovered. Only one capsule of film is obtained per launch (or, to be precise, per payload). The proposed new system is directed towards extending the useful life of future USAF reconnaissance spacecraft.

The USAF is reported to be working on a system of multiple re-entry capsules which would be carried aboard a single Titan 3 payload. Weighing less than 500lb each, the capsules could manœuvre during re-entry and could attain up to 600 miles of cross-range manœuvring, possibly through the use of ablation-cooled lifting-body techniques. According to a report in *Aeronautics and Astronautics*, "Not only would these small capsules permit much longer useful life for expensive camera systems, but they might also provide the means for securing 'real-time' intelligence such as post-strike damage assessment, even where the orbits of the reconnaissance satellites themselves are unfavourable for return of data by conventional ballistic means now employed."

Apollo simulator (2): this nine-ton circular platform rests on a single stainless-steel bearing on a thin gas-cushion, isolating the platform from friction and vibration and simulating characteristics of the command module of the Apollo spacecraft. An engineer, on ladder, checks gas jets used to manœuvre the platform. The device was developed for NASA by the Honeywell Corporation at Minneapolis



BRITISH EXPERIMENT FOR FRENCH SATELLITE

An electron-density experiment devised by Prof J. Sayers of Birmingham University is to form part of the first French satellite payload, FR-1, to be launched by NASA Scout vehicle from the Western Test Range in the USA later this year. This experiment, similar to that contributed by Prof Sayers to the first joint US/UK satellite Ariel 1, has been under development at Birmingham during the past 12 months, and will be installed in FR-1 by arrangement with the French National Centre for Space Studies (CNES) and National Centre for Telecommunications Studies (CNET).

Anglo-French co-operation in space science has already included joint sounding-rocket work by University College, London and the French Meudon Observatory, involving flights by Centaure rockets from the Sahara. In this programme the relationship between sporadic-E ionization and high atmospheric wind structure has been examined, and significant electron-temperature data has been obtained by UCL instruments aboard one of the French rockets passing through a sporadic-E layer.

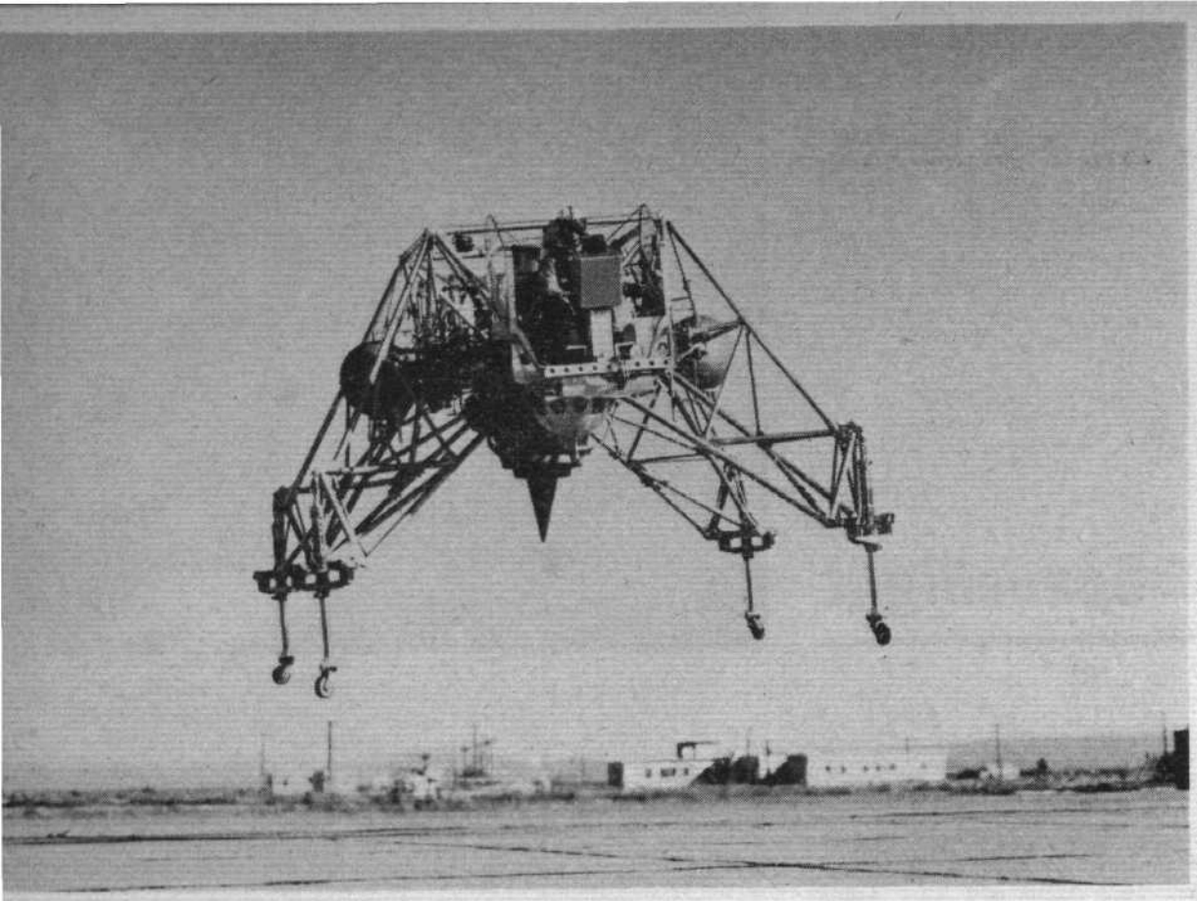
GEMINI/APOLLO CHANGES

NASA has " realigned" its manned spaceflight organization "to meet the requirements imposed by current Gemini and Apollo launch schedules." Main change is the introduction of a new senior headquarters position, Mission Operations Director in the Office of Manned Space Flight, to which Everett E. Christensen has been appointed. Previously test manager, missiles systems division, Lockheed Corporation, Mr Christensen will be responsible for planning, co-ordinating and directing all activities involved in the conduct or support of NASA manned spaceflight missions, and of unmanned flight tests of spacecraft types which will be flown on manned missions.

Among a number of other changes is the appointment of Dr Kurt Debus as Director, Launch Operations, in addition to his job as Director of NASA's Kennedy Space Center in Florida, following the transfer of the Manned Spacecraft Center's Florida Operations to the Kennedy Center. This move "places the responsibility for assembly, checkout, and launch of the total Apollo space vehicle with a single organization."

Five Agena D Stages are to be modified for NASA by Lockheed Missiles and Space Co for Atlas Agena flight by Lunar Orbiter spacecraft, under an incentive-type contract expected to amount to about $6m.

Spaceflight



NASA's lunar landing research vehicle (LLRV), pictured during its first flight at Edwards, California, on October 30 last

PRACTISING LUNAR LANDINGS

EDWARDS, California, is the home of the strange bird pictured above. At the National Aeronautics and Space Administration's Flight Research Center, pilot familiarization and check-out flights on this, NASA's lunar landing research vehicle, are soon to be followed by simulated lunar missions.

The vehicle will be used to study the piloting and operational procedures involved during the final phases of a manned lunar landing and during the initial part of the lunar take-off. Areas of interest include control systems, pilot displays, systems operations, pilot visibility requirements, and vehicle dynamics. The LLRV may also be used as a trainer for the actual lunar astronauts and to flight-test actual landing equipment.

To attain flight conditions similar to those found on the Moon, where the force of gravity is only one-sixth of that on Earth, the LLRV is equipped with an automatically controlled jet engine regulated to counter-balance five-sixths of the vehicle's weight. To achieve the effect of operating on the surface of the Moon, where there is essentially no atmosphere, the vehicle was designed to be as non-aerodynamic as practical, and automatic devices compensate for the remaining aerodynamic forces and moments.

The research vehicle is slightly more than 10ft high, and is fitted with four aluminium truss legs with a spread of 13.3ft. A General Electric CF 700 turbofan engine is attached to a gimbal system at the apex of the legs. A plexiglass-shielded pilot's platform extends forward from the top of the fuselage. The complete LLRV weighs about 3,600lb.

Two pilot-controlled hydrogen-peroxide rocket motors which can be regulated from 100 to 500lb of thrust are used to provide lift for the vehicle. Six additional lift rockets are provided for emergency use. Two sets of eight reaction control rockets are used in pairs to control the attitude of the vehicle in flight. The vehicle was built for NASA by Bell Aerosystems, Buffalo, New York, in support of Project Apollo.

First flight of the LLRV was made by project pilot Joseph A. Walker on Friday, October 30. The flight consisted of three separate take-offs and landings. Total free flight time was just under 1min, with a maximum altitude attained of approximately 10ft. Walker reported that he utilized only the jet engine for lift power and did not activate the lift rockets. He did, however, operate all eight of the standard control rockets for short periods of time.

A NASA contract for the study of the touchdown dynamics of the lunar landing research vehicle, it was announced earlier this month, has been awarded to the Bendix products aerospace division. This covers a four-month study period in which the division will use high-speed computers in determining the reaction of the vehicle's landing gear to operating conditions.

The study also will be based on computer programmes and techniques previously established to determine shock-strut response characteristics during the designing of the vehicle's struts. The use of these programmes should eliminate the need of extensive drop-tests and permit NASA to examine critical landing problems prior to actual flight testing of the vehicle.

Joseph A. Walker, project pilot, and lunar landing research vehicle

SPOT YOUR AIRFIELD 11

WHERE ARE YOU?

Keep your airfield recognition up to scratch by giving a name to this airfield somewhere in Britain. If you don't know it or guess it straight off, here are some clues to help you.

The name of the Airport Manager is Mr. W. K. Finlayson.	The name of the Airport Depot Supervisor is Mr. W. Mackay.	The main runway headings are: 01/19; 07/25; and 12/30.	Several first-class hotels available.
		The height of the airfield is 30 feet AMSL.	Taxis, public transport and hire cars are available.
		Add the lifeblood of any airport —AVGAS 80, AVGAS 100/130 and AVTUR.	Restaurant facilities available at the airport.
		The approach and tower frequencies are:— 118·3 and 121·5 Mc/s.	**GOT IT YET?** Here's another clue. Centre of Harris Tweed Industry.

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Spaceflight

Design of a Spacecraft

2. SYSTEM INTEGRATION, ENVIRONMENTAL QUALIFICATION AND LAUNCH PREPARATION

AN OUTLINE of the design of the Ariel 2 satellite was given in the paper *Achieving Ariel 2 Design Compatibility* by Allen F. Franta of NASA's Goddard Space Flight Center at the one-day symposium organized by the British Interplanetary Society in London on January 5. The first instalment of a condensed version of Mr Franta's paper was given in last week's issue. This covered feasibility study and project approach, system design specifications, subsystem design specifications, and fabrication and test of structures and subsystems. A condensed version of the remainder of the paper is given in this article.

Whenever delivery schedules permitted [Mr Franta stated] interdependent subsystems were interconnected as a partial system during tests. This provided a close check on the compatibility of the assemblies during test conditions which more closely duplicated the interconnecting complex of the completed spacecraft.

During the development of the Ariel 2 subsystems, numerous modifications were necessary to secure the desired circuitry performance during environmental testing. Without adequate control via project management, these modifications would have been a source of severe incompatibility. Careful analysis of all component failures were made and documented throughout the project development. The current Goddard philosophy holds that the words "random failure" are meaningless and misleading, and that every failure must be analyzed and explained.

System Integration After all the subsystem and experiment hardware had been produced and qualified, it was furnished to the project office for the detailed technical integration. The overall system integration, co-ordination and solution of all interface problems was accomplished through the joint effort of the project management staff and the mechanical and electronic integration groups.

The integration of the spacecraft was accomplished at the aerospace division of the Westinghouse Electric Corporation under the direct supervision of the Goddard project management. A compatibility test layout board was constructed, and complete spacecraft systems or subsystems were inserted in this test complex prior to physical integration in the actual spacecraft.

The Ariel 2 prototype required eight major modifications and six minor modifications. The major modifications were: (1) addition of staticizer subsystems to stabilize the data rate during the data sampling time, (2) addition of pre-amplifiers to the instantaneous read-out detector assembly of the micrometeoroid experiment, (3) introduction of a low-level degausser to correct frequency shifts of encoder oscillators, (4) installation of light baffles between the ozone spectrometers, (5) addition of voltage stabilizers to remove crosstalk between the galactic-noise experiment and the micrometeoroid experiment via the common 12 volt supply, (6) replacement of capacitors in the foil-advance units by improved models, (7) introduction of 47K resistor to remove double triggers in the trigger and selector units of the micrometeoroid experiment, and (8) replacement of resistors used in the ozone electronic packages by improved models. All of these changes were expedited to secure a minimum schedule slip during integration.

The overall satellite integration was started as soon as system compatibility on the test layout board was achieved. The subsystems were inserted in the spacecraft as related partial systems. These systems were checked prior to the insertion of additional related partial systems. The final check was an overall test with all of the spacecraft subsystems and experiments installed.

As a compatibility test for operation in sunlight, the prototype and flight spacecraft were placed on a rotator and rotated at 5 r.p.m., the nominal orbital spin rate. This proved the capability of the solar power supply and the operation of the micrometeoroid and ozone experiments. The compatibility of all subsystems with the solar power rotation perturbation was checked.

After a final series of systems tests on the spacecraft, and final inspection, the satellite and ground-handling equipment were transported to Goddard for experiment calibration and environmental tests.

Environmental Qualification The environmental tests of the Ariel 2 satellites were conducted to evaluate their performance when exposed to launch and orbital environments. The prototype was subjected to test levels above the required levels to prove the desired over-rate factor. On the prototype the following tests and calibrations were made: aerial pattern test, experiment calibration, vibration, experiment calibration, temperature and humidity, acceleration, thermal vacuum, experimental calibration, solar simulation, experiment calibration, spin-up and separation, aerial pattern test.

On the flight units, the sequence was: aerial pattern test, experiment calibration, vibration, experiment calibration, temperature, thermal vacuum, experiment calibration, aerial pattern test.

Continuous monitoring of test points throughout the satellite is desirable during any of the above tests; however, too many hard-line connections to the spacecraft may introduce noise and short-duration anomalies.

Launch Preparations Prior to the launch preparations, periodic conferences between the Scout vehicle project personnel and the Ariel 2 project personnel were held to ensure compatibility of the spacecraft requirements with the vehicle requirements. Six months prior to the launch date, the project management staff prepared a payload description document, which contained all the launch operation requirements.

An operations directive for the launch of Ariel 2 at Wallops Station was published and distributed by the Scout Project Office of the Langley Research Center. Directly prior to the spacecraft deployment for launch, the following pre-launch schedules were made as firm as inputs at the time would permit: vehicle systems tests schedule; payload systems test schedule; vehicle assembly schedule by Langley and Wallops Station; payload mating schedule; and countdown schedule.

Launch Operations To provide a practice run of all launch operation events, the Ariel 2 prototype was transported to Wallops. The practice launch operations included vehicle payload compatibility checks, payload mating and spin balance on a dummy fourth stage, nose fairing installation around the mated payload and dummy fourth stage, transferring the assembly to the gantry, and simulating erection of the completed assembly atop the vehicle.

The practice run proved to be very informative. Deficiencies of procedures and facilities were discovered during this simulated launch operation. Personnel became experienced in procedures. The practice launch operation was accomplished three days prior to the launch operations of the Flight 1 spacecraft.

The launch operations were conducted according to the following schedule:—

Days Required	Ariel 2	Scout Vehicle
15	Spacecraft systems tests	Vehicle systems tests
4	Spacecraft mounted on fourth stage, assembly balanced, heat shield installed	First, second and third stages erected on launch pad, operations check and environmental control check
1	Completed assembly erected on Scout third stage	Assembly inspection

A countdown rehearsal was conducted two days prior to launch. During the final countdown, which was completed in 8hr, one compatibility problem appeared. The galactic noise experiment had a high-level interference signal appear during a "turn-on" test in the early part of the countdown. A check of the immediate area revealed an atmospheric sounder transmitter operating about one mile from the launch site. The interference disappeared from the experiment output as soon as the sounder was turned off.

Spaceflight

ESRO'S 1965 PROGRAMME: PAYLOADS AND CONTRACTS

BRITISH scientists are contributing a healthy proportion of the experiments now being developed for initial satellite and rocket payloads of the European Space Research Organization (ESRO). The Organization itself has negotiated a number of major contracts within the past year for facilities at its establishments, for rocket vehicles, payloads and design studies.

ESRO's sounding-rocket programme for 1965 (see table) consists of 33 experiments, distributed over 14 payloads and launched by 28 rockets. Two rockets are assigned to duplicate payloads in each case, to increase the probability of success. Contracts are being placed for the purchase by ESRO of 28 Centaure rockets from Sud Aviation of France and 20 Skylark rockets from British Aircraft Corporation.

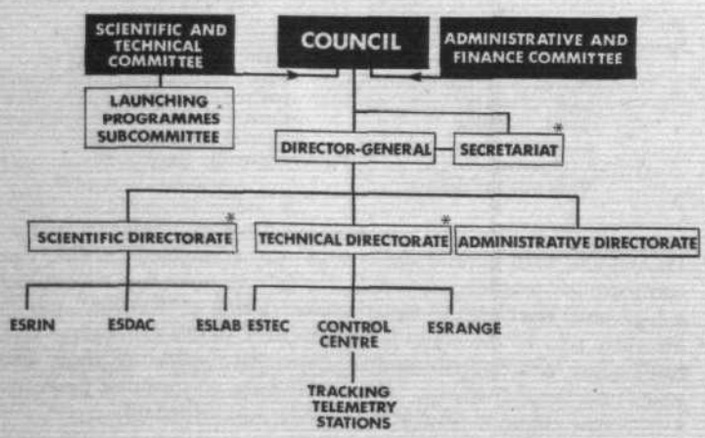
ESRO's first satellite, incongruously designated ESRO 2, is scheduled to be launched by Scout from the Western Test Range in the USA in the spring of 1967. It is designed to study solar X-rays and cosmic radiation, and will carry the following experiments:—

X-ray intensity, 1-70Å	Leicester U, UC London, Utrecht U
Trapped radiation	IC London
Solar protons and inner Van Allen belt protons	IC London
Cosmic-ray alpha particles	IC London
Cosmic-ray beta particles	Leeds U
Protons, 35-1,000 MeV	CEN Saclay

A contract for the development of ESRO 2, as announced last month, is being negotiated with Hawker Siddeley Dynamics, who will subcontract part of the project to Engins Matra. Contracts for the telemetry and telecommand equipment aboard ESRO 2 will be awarded by ESRO upon completion of a call for tenders which is being made in ten countries. Preliminary design studies for ESRO 2 had earlier been carried out by Ateliers de Construction Electrique de Charleroi (France) and by Ecole Polytechnique de Zurich (Switzerland).

First joint NASA/ESRO working group meeting on the ESRO 2 satellite was held at Goddard Space Flight Center in Maryland last October. ESRO representatives comprised S. E. Shapcott, R. Pacault, U. Grossmann-Doerth, D. L. Oldroyd and A. Kutzer;

Organizational structure of ESRO, with the groups whose membership consists of delegates from each member-country shown in black. Of the three sections marked with an asterisk, the secretariat deals with official external relations, the technical directorate with relations with industry, and the scientific directorate with relations with universities and national institutes. The establishments comprise ESRIN, a proposed research institute in Italy; ESDAC, the data centre at Darmstadt; ESTEC, the space technology centre, and ESLAB, the space laboratory, in the Netherlands; and ESRANGE, the rocket launch site at Kiruna



ESRO SOUNDING-ROCKET PROGRAMME 1965

Payload, Rocket and Launch Site	Experiments	Experimenters
Payload I Skylark Sardinia (sunset)	Barium release	Dr Lüst, Max Planck Institute, Munich
	Grenade experiment and trimethyl aluminium release	Dr Groves, UC London
Payload II Skylark Sardinia (night)	Stellar UV photometer	Dr Butler, Royal Observatory, Edinburgh
	Stellar UV sprectrophotometer	Dr Butler, Royal Observatory
Payload V Centaure Sardinia (afternoon)	Solar X-ray experiment	Prof de Jager, Sonnenborgh Observatory, Utrecht
	Solar X-ray and air-density measurements	Prof Stewardson, Leicester University
Payload A3 Centaure Sardinia (2 p.m.)	Mass spectrometer for neutral particles	Prof Priester, Dr von Zahn, Physics Institute, Bonn
Payload A2 Skylark Sardinia (twilight)	Barium release	Dr Lüst, Max Planck Institute, Munich
	Vertical ozone	Dr Frith, Meteorological Office
Payload VII Centaure Sardinia (one night, one day)	Inverse Seddon experiment	Prof Rawer, Ionosphere Institute, Breisach
	Impedance probe	Prof Rawer, Breisach
	Positive ion probe	Prof Boyd, UC London
Payload VIII Centaure Sardinia (day)	Inverse Seddon experiment	Prof Rawer, Breisach
	Negative ion probe	Prof Boyd, UC London
	Electron temperature probe	Prof Boyd, UC London
Payload D4 Skylark Sardinia	Night sky spectrometer	Dr Butler, Royal Observatory
	Low-energy photon experiment	Prof Brini, Physics Institute, Bologna
Payload ATM 5 Skylark Sardinia	Solar X-ray experiment	Prof de Jager, Utrecht
	Grenade experiment (possible co-operation)	Dr Groves, UC London Prof Bolin, Stockholm
Payload G1-A Belier Sardinia	Neutron albedo	Prof Occhialini, Physics Institute, Milan
Payload B3 Centaure Andoya, Norway (night)	Auroral particle experiment	Dr Hultqvist, Kiruna Geophysical Observatory
	Inverse Seddon experiment	Prof Rawer, Breisach
	Negative ion probe	Prof Boyd, UC London
	Faraday rotation experiment	Mr Petersen, Ionosphere Laboratory, Copenhagen
Payload B4 Centaure Andoya, Norway (night)	Auroral particle experiment	Dr Hultqvist, Kiruna
	Positive ion probe	Prof Boyd, UC London
	Faraday rotation experiment	Mr Petersen, Ionosphere Laboratory, Copenhagen
Payload PLA 2 Skylark Sardinia	Barium (strontium) release	Dr Lüst, Max Planck Institute, Munich
Payload PLA 3 Skylark Sardinia	Ammonium release	Prof Rosen, Institute of Astrophysics, Cointe-Sclessin
	OR	
Payload ION 2 Skylark Sardinia	Inverse Seddon experiment	Prof Rawer, Breisach
	Electron temperature probe	Prof Boyd, UC London
	Vertical oxygen distribution	Dr Frith, Meteorological Office

NASA's project manager for the spacecraft is Robert C. Baumann, well known to British scientists as project manager for Ariel 1.

ESRO's second satellite, the polar ionospheric ESRO 1, is expected to be launched approximately six months after ESRO 2. Its experiments will comprise:—

Flux and energy spectrum of electrons and protons	Denmark TU, RRS Slough, Kiruna GO
Electron temperature and density	UC London
Ion composition and temperature	UC London
Auroral photometry	Oslo U, QU Belfast

Preliminary design studies for ESRO 1 have been carried out by Centro di Ricerche Aerospatiali (Italy) and by the SAAB company (Sweden). These studies are complete and tenders for satellite development have been sent out.

The Organization's first large, stabilized satellite should be launched in 1968-69; its preliminary payload contains the following experiments relating to stellar astronomy:—

Infra-red scanning	Liege U
Multicolour scanning in 1,000-3,000Å ..	RO Edinburgh, Liege U
Ultra-violet spectrography of stars	Utrecht U
X-ray photon spectrometry in 3-30KeV ..	CEN Saclay
Gamma-ray astronomy	Southampton U

Since the ESRO Convention entered into force in March 1964 the Organization has signed the following contracts:—

Rockets and Ancillary Equipment Ancillary equipment for Centaure rockets, Sud-Aviation, France; components for onboard telemetry equipment, Société Anonyme des Télécommunications, France; development of the first Centaure payload, Sud-Aviation, France.

Launching Ranges Telemetry aerials for Sardinia and Kiruna, Elektro-Metall, West Germany; electric power line for Kiruna, Jukkasjarvi Sockens Belyanings Forening, Sweden; Kiruna site preparation, AB Gravmaskiner, Sweden; construction of buildings at Esrange, Paul Anderson, Sweden; ionosonde observations and measurements, Sardinia range, Max Planck Institute, West Germany.

European Space Technology Centre (ESTeC) Planning and design of ESTeC, Steensen and Varming, Denmark; design study for space environment simulator, SEAVOM, France; multi-channel telemetry testing station, Type A-145, Société Electronique, France, and Airpax, USA.

Telemetry Station Design and preparation of specification for the civil engineering of the telemetry and tracking station in Belgium, SONECTRO, France.

A number of other important contracts are now under negotiation:—

ESTeC Construction of the building for environmental testing facilities at Noordwijk, Aanneming van Werken v/h H. J. Nederhorst, Netherlands; thermal vacuum test facilities, High Vacuum Equipment (USA), European consortium of Hereaus (West Germany), Associated Electrical Industries (UK) and Sogev (France); design study for space environmental simulator, Associated Electrical Industries, UK.

Esrange, Kiruna Civil engineering works and buildings on the launching range, several Swedish firms; wind-measuring tower, CERCI, France.

ESDaC, Darmstadt Study of the buildings for the Computation Centre, Rhein-Rhur, West Germany.

Senior ESRO staff have had discussions recently with a number of other organizations including NASA, the World Meteorological Organization and the European Conference on Satellite Communications (CETS). The chairman and vice-chairman of the CETS space technology committee visited the Technical Director of ESRO at ESTeC; senior ESRO scientists visited the USA to study the Orbiting Astronomical Observatory and other projects; and senior NASA representatives have visited ESRO in Paris.

Satellite-experiment research organizations (abbreviated in lists) include Sonnenborgh Observatory, Utrecht University; University College, London; Imperial College, London; Leicester University; Leeds University; Centre d'Etudes Nucleaires de Saclay; Technical University of Denmark; Radio Research Station, Slough; Geophysical Observatory, Kiruna; Oslo University; Queen's University, Belfast; Royal Observatory, Edinburgh; Astrophysics Institute of Liege University; Southampton University.

This 2½-ton dummy adapter section of NASA's Apollo spacecraft was delivered from North American Aviation's plant at Tulsa, Oaklahoma, to Cape Kennedy, a distance of 1,000 miles, by US Army Chinook helicopter in 16 flying hours. The trip was made in five legs with two over-night stops, cruising at 2,000ft and averaging 90 m.p.h.

TRACKING NETWORK COMPLETED

The seventh link in the USAF chain of global tracking stations has been completed at Pretoria, South Africa, and successfully employed to track space vehicles on the Air Force's Eastern Test Range. The Glotrac station, a long baseline interferometer tracking facility, is claimed to be able to detect a change of less than one inch in the motion of a vehicle 100 miles overhead.

Announcement of the new installation and its first successful tracks was made on January 12 by General Dynamics' electronics division, designer and manufacturer of Glotrac stations for the Air Force Missile Test Center at Patrick Air Force Base, Florida.

The new Pretoria tracking station acquired the recently orbited Titan 3A and Centaur AC-4 vehicles after they had passed over the radio horizon of the other six uprange Glotrac stations. Together, the seven stations make up the present Glotrac network on the Eastern Test Range, formerly known as the Atlantic Missile Range.

The addition of the Pretoria station is expected to enable the network to yield data representing a major improvement in tracking accuracy. The other six Glotrac links are located at Atlantic Field, North Carolina; Cape Kennedy, Florida; and on the British West Indies islands of San Salvador, Grand Turk, Antigua and Bermuda.

The Pretoria station is similar to all Glotrac continuous-wave tracking stations. Its sensitive electronic tracking and data processing hardware are housed in a mobile, 40ft air-conditioned van for ease of transportation by air, sea or road to a tracking site. The system is designed to track vehicles more than 23,000 miles into space, determine velocity to better than 6in per second, and pinpoint location to within 100ft.

The network's primary assignment is to provide accurate tracking information necessary for post-flight mission analysis. It is also used extensively to evaluate the performance of on-board missile guidance systems.

Cosmos 52 was launched into Earth orbit by the Soviet Union on January 10. The customary type of Cosmos launch announcement issued by Tass quoted an initial period of 89.5min, apogee 304km, perigee 205km and inclination 65°. The craft was reported to have a radio transmitter operating on 19.995Mc/s.

One of six French helicopters reported to have flown under Sydney Harbour bridge, this Aéronavale Alouette 3 is flying over Sydney during the visit of the French carrier "Jeanne d'Arc" and other warships

DEFENCE

F-5s for Spain

SPAIN HAS DECIDED to buy 70 Northrop F-5s in both single- and two-seat versions. This is an outright purchase, not an MAP allocation, and Construcciones Aeronauticas (CASA) are to take part in production or assembly at their Madrid factory. The exact extent is not yet decided.

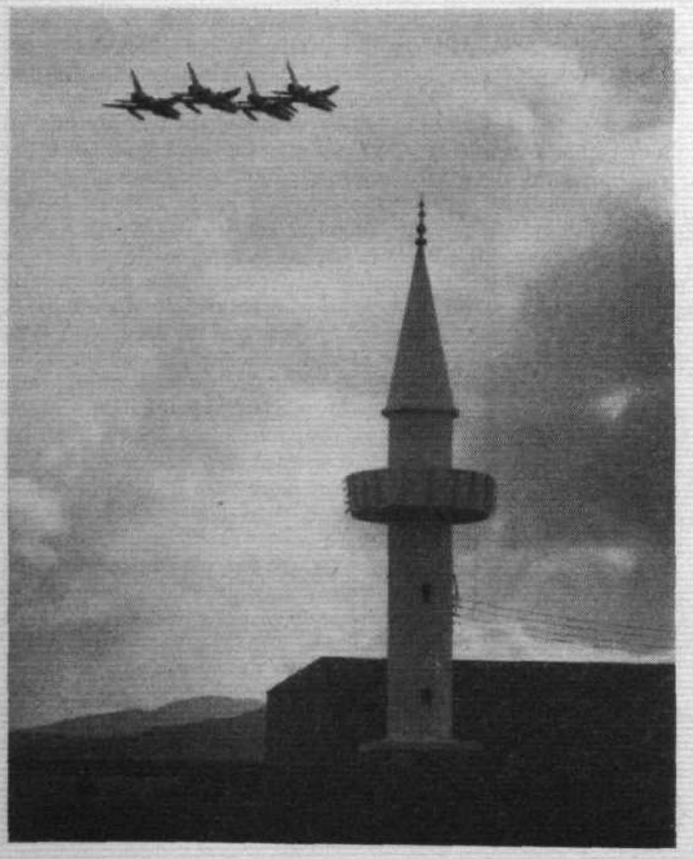
Spain thus becomes the eighth country to buy or be given F-5s—the others are Norway, Iran, South Korea, Greece, Turkey, the Philippines and Nationalist China. Cost of the Spanish aircraft is stated to be £16.8m, equivalent to £240,000 per aircraft, which is a good deal less than the previously reported cost of the Norwegian aircraft. CASA's Madrid factory has considerable experience of overhaul work for the USAF and has an excellent cost and quality record.

Cut-away drawings and the latest status of the F-5 programme appeared in *Flight* for December 17.

V-bombers for Darwin

A DETACHMENT OF RAF V-bombers, said in Canberra to be less than six, is to fly to Darwin, in Northern Australia, next month from Singapore, to take part in "joint mobility exercises" with the RAAF. The exercises, which are more likely to be involved with checking the Australian radar control and reporting network, are officially said to be planned to last a few days.

Despite Australian denials that the bombers' detachment to Darwin has any relation to the increasing tension in the Malaysian - Indonesian theatre, advance maintenance parties and support equipment have left Singapore for Darwin by sea, indicating that the V-bombers may be expected to operate from Darwin for some time. Obviously their presence there cannot be divorced from the present situation *vis-à-vis* Indonesia.



Even the mosque is American in this picture. The F-100s are flying over the mosque built by USAF Europe at Cigli air base in Turkey for Turkish personnel working on the base

Northrop Offering Naval Fighter

AN UNANNOUNCED SUPERSONIC naval fighter, for both fleet defence and strike duties, was recently offered by Northrop to the RAN. Designated the N-285B, the aircraft is similar in appearance to the F-5 Freedom Fighter, now being built in hundreds for eight air forces, but incorporates special features for operation from carriers. The N-285B is closely related to Northrop's proposal to the USN for an advanced supersonic trainer compatible with carrier operations and this project is itself a growth version of the F-5/T-38 Talon family.

No requirement for a naval fighter has been indicated by the Australian Government, whose defence programme announcement emphasized the switch in the Australian Fleet Air Arm to purely ASW duties with news of an order for Grumman Trackers which, with Wessex helicopters, will certainly fill the one RAN carrier, HMAS *Melbourne*.

On the same Australian visit during which the N-285B was discussed, Northrop officials discussed the T-38 Talon—the USAF's standard advanced trainer—with the RAAF. The company hopes the RAAF will establish requirements for a supersonic trainer with similar flight characterist-

ics to the T-38 after placing its intended order for 75 subsonic trainers. An RAAF evaluation mission is expected in the USA and Europe in the spring and arrangements are being made for the team to fly the T-38 in California.

Malaysia's Eighth Herald

ON MONDAY OF LAST WEEK Handley Page handed over the eighth and final Herald 400 military transport to the Royal Malaysian Air Force. The aircraft was then flown to Kuala Lumpur, base of 4 Sqn, RMAF, the Herald unit, by the squadron commander, Sqn Ldr D. R. Bryan.

The RMAF has been intensively flying its Heralds since the first aircraft was delivered in November 1963. The first four aircraft did not have the inward-opening freight door which can be opened in flight to allow air-dropping, but modifications may follow. One Herald is furnished as a VIP transport.

Reliability and simple maintenance have been the outstanding features of the Herald. Engineering personnel seconded from the RAF have noted that the Herald performed profitably right from the start: aircraft delivered to the RAF, they said, rarely produced much useful service during their first six months with squadrons.

The RMAF has been carrying out intensive trooping flying, both within mainland Malaya and to Borneo. Single Heralds are sent on five-day detachments involving some 25 hours' flying and up to 24 landings. During this time the aircraft are maintained and refuelled by the normal flight crew. Some days involve 10½ hours' flying and three refuellings in 12½ hours' elapsed time.

Total RMAF Herald flight time is now more than 4,000hr. Both RMAF and Royal Jordanian Air Force Heralds are being flown back to Radlett for major overhaul when required.

Losses in Laos

DURING AN AIR ATTACK on communication lines for Viet Cong supplies passing to Viet Nam through Laos on January 13 an F-100 and an F-105 were shot down. The two aircraft were part of a force of 22 and both pilots were subsequently recovered.

During last summer several USAF fighters were shot down over the Plaine des Jarres, but were then engaged in reconnaissance flights against the Communist Pathet Lao.

This Nylfrance-Aérazur arrester net has made more than 100 actual arrests. In this instance it caught Adj Rothheuth's Belgian Air Force RF-84F at more than 100 m.p.h. at Liège Bierset

XC-142A Completes Transition

ONLY TWO WEEKS after its first hovering flight, the "tri-service" Vought Hiller Ryan XC-142A tilt-wing transport, illustrated in these pages last week, made its first full transition cycle from vertical take-off to forward flight, and back again, at Dallas on January 11. The operation was reported to have been "as near perfect as you can get—flawless." The first hovering flight had been made at a gross weight of 36,500lb—1,000lb below design VTOL weight. Before the transition, the XC-142A had been flown at 26kt at 10,000ft with the wing tilted 40°. Vought, Hiller and Ryan are together building five XC-142As for joint service evaluation under the direction of the USAF.

Lauthala Closing

THE RNZAF FLYING BOAT BASE at Lauthala Bay, Fiji, is being officially closed at the end of this month, although two Sunderlands and 103 men are remaining as a detachment from RNZAF Hobsonville.

No 5 Sqn, which has been based at Lauthala since World War 2, with Catalinas and then with Sunderlands, has held surveillance and anti-submarine responsibility over a very wide ocean area and has also contributed a great deal to local search and rescue work. The last Sunderlands are to remain at Lauthala until the RNZAF receives its P-3 Orions.

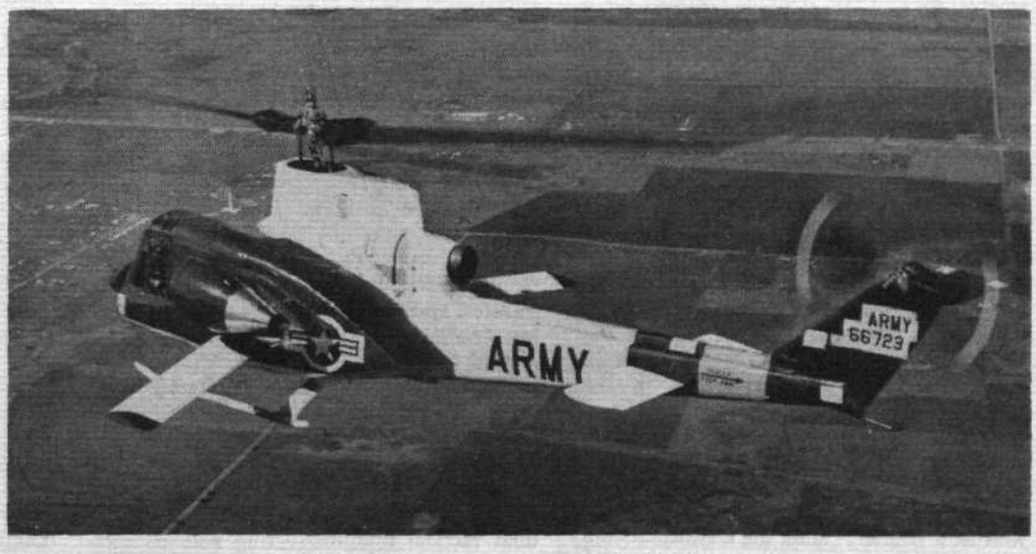
Another U-2 Down Over China

A CHINESE NATIONALIST AIR FORCE U-2 reconnaissance aircraft was downed over Northern China early last week, claimed Peking radio. Nationalist headquarters in Taipeh later confirmed that a U-2 had indeed been lost over mainland China, but euphemistically described the loss as "an accident." Identifying the pilot, a major, Taipeh sources said that he had flown five previous reconnaissance missions over China in recent months.

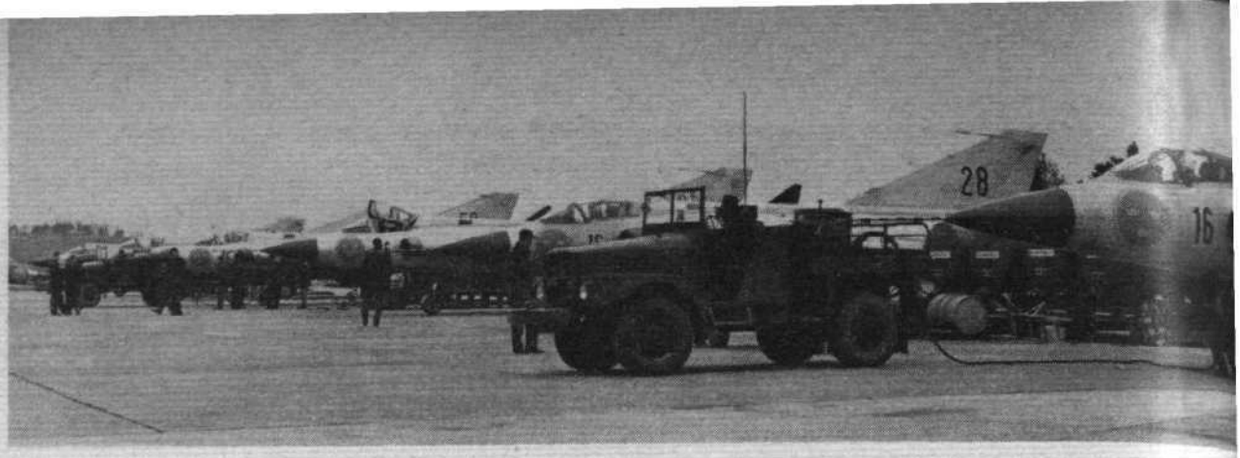
Otters for Indonesia Suspended

DELIVERY OF EIGHT DHC OTTERS, ordered last month by ICAO for the UN Fund for the Development of West Irian (now part of Indonesia) and due to begin next month, is being suspended by the Canadian Government while "the situation is examined." Suspension follows strong diplomatic representations from Britain last week against the sale. Otters previously delivered to Indonesia are known to have been engaged in guerilla support operations in Borneo.

With vestigial wings and two 1,700lb thrust Continental J69 turbojets, this US Army Bell model 533 has already exceeded 222 m.p.h. in speed and control trials for the US Army Transportation Research Command. It is one of several such research projects. The compound helicopter is now thought to be the best answer to the Advanced Aerial Fire Support System requirement. Two compound helicopters and a tilt-wing V/STOL type are likely to be chosen, out of 100 submissions, for more detailed study



DEFENCE



Saab J35A Drakens of F-16 Wing at Uppsala. The standard handling truck has a 28V generator ahead of the engine to run electronics and instruments on the ground

One of the two-seat Sk35C Drakens used by F-16 Wing for conversion training of newly graduated pilots. Next to it are transportable fuel tanks, a cluster of which stands ready beside every aircraft parking position on the main apron

New RSAF Training Sequence

THE ROYAL SWEDISH AIR FORCE is planning to introduce a new training system in which foreign air forces have shown considerable interest. It will involve 160hr on the new Saab 105 at the Swedish Central Flying School, followed immediately by a 60 hours' conversion course on the Draken in the operational wing at Uppsala. Initial operational training will occupy a third stage integrated in another operational Wing, and this is to be followed by a final year of operational training on the complex systems now being introduced in the J35D Draken (see also "Draken In the Air" on page 102).

In the present training system, the Central Flying School in Southern Sweden gives student pilots 160hr during the first year on Safirs and Vampires. Pilots then move to operational squadrons for 150 hours' training, which brings them to a combat-ready status. Those selected for the J35 Draken go to F-16 Wing at Uppsala for a 25 hours' conversion course which makes them combat ready for day flying and the use of the Sidewinder missile. A further 60hr brings them to a fully all-weather standard covering all the Draken's roles.

The new system will thus eliminate in due course the intermediate stages, as the Viggen takes the place of Lansens and other types. Pending the introduction of the Saab 105, the first of which is to be delivered at the end of 1965, the F-16 Wing at Uppsala has already converted several courses of pilots fresh from Safirs and Vampires. As the scheme builds up, three courses of 18 pilots each will be overlapping in the training system.

In the interests of economy in a relatively small air force, operational training is already based on operational wings, but the Saab 105 is itself an operational aircraft as well as a trainer. Thus the Central Flying School will become an operational pool with instructors proficient in ground attack. The objective is always to be able to throw as much force as possible into the very earliest stages of a defensive battle. The 105 overcomes the penalties of relatively modest performance when operating against heavily defended targets by launching the new Saab 305 air-to-surface missile as a penetration weapon.

For a pilot with 160hr total experience, the step from Vampire Trainer or Saab 105 to Draken is, of course, a very big one, but the RSAF has arranged a very successful 23-week course involving 30hr in the Sk35C two-seater, 30hr in the J35A intercepter and 25hr in the Curtiss Wright Dehmel flight simulator, two of which are installed in a special building at Uppsala. Main features of this course are that the pilots fly the two-seater at a very early stage, go solo in it after about 12hr dual, and that the RSAF appreciates that a good simulator pilot is not necessarily a good aircraft pilot. For the first four flights the trainee is in the rear seat. The fifth flight is made from the front seat, and the first solo is made in the two-seater after eight weeks and after only 9hr in the simulator. Thereafter the trainee flies more solo than dual, but the limited sortie duration of about 30min is put to best use by careful pre-flight planning, simulator training and dual instruction. Strong emphasis is placed on uniformity of procedures, and it is noteworthy that the flying instructors also control the simulator. Actual flying at the earliest possible stage prevents students becoming nervous as they learn more and more about the aircraft.

That this training scheme has so far proved successful reflects great credit on the individual instructors who are of a high calibre and who are able by virtue of their dual tactical and instructing role to give each trainee close contact with operational flying and an early introduction to the aggressive outlook of the combat pilot. In this respect the natural Swedish emphasis on physical fitness and competitive games seems to be of considerable assistance, and the sports facilities at Uppsala are excellent.

RSAF instructors are picked among operational pilots and given a 2½ months' course. Of the recruits, some 5 per cent of the 1,400 applicants for pilot training each year are initially accepted—a proportion similar to that in the RAF. As the tactical flying task changes from the hell-for-leather single-seat tradition to the all-weather systems methods, the RSAF is finding that rather older pilots are preferable for operational flying. Pilots continue on flying duties to the age of 38 or 40 and may then become instructors or transfer to the defence and control departments. The RSAF has both officer and non-commissioned, career and short-service pilots.

"Wings" Tips the Macchi

THE SOUTH AFRICAN JOURNAL *Wings Over Africa* reported recently that the Macchi MB 326 is the jet trainer/ground-attack aircraft to be built under licence by the nascent South African aircraft industry, the Atlas Aircraft Corporation.

Flight stands by its recent forecast that the French Fouga Magister will prove to be the type put into production when the Atlas factory, expected to be in the Southern Transvaal, becomes operational in about 18 months.

IN THE NEWS ITEM "RAF Honours" on this page two weeks ago, errors occurred. Correctly, Air Chief Marshal Sir Walter Cheshire was appointed GBE in the New Year Honours List and Air Marshal P. H. Dunn and AVM D. J. P. Lee both KBE.

ACTION AND REACTION

A Crisis-week Diary

See also World News page 80

Speakers' Corner, Hyde Park, January 14; aircraft industry men hear speeches from trade union leaders Percy McNally, Clive Jenkins and George Elliott

Monday, January 11 was a busy day in Paris and in London. The Plowden Committee assembled for its first formal meeting in Shell-Mex House in the Strand, pausing only briefly for photographs before getting down to business.

Arriving back in London from Concorde talks in Paris, Sir George Edwards, managing director of British Aircraft Corporation, joined five other BAC directors for a company-requested meeting with the Minister of Aviation that evening. The five were Lord Portal, BAC chairman; Sir Reginald Verdon Smith, Bristol Siddeley chairman and BAC director; Sir Charles Dunphie; Lord Nelson; and Mr William Masterton. After a 1¾hr meeting at the Ministry, Lord Portal reported: "We had a sympathetic hearing from the Minister. There was no decision about the TSR.2. We pointed out the implications of possible cancellation of the project." The group asked Mr Jenkins to arrange a meeting with the Prime Minister. Mr Jenkins himself had flown to Paris earlier the same day for Concorde talks with his opposite number, M Jacquet.

After lunch on **Tuesday, January 12,** several thousand BAC employees assembled outside the main gates of the company's Weybridge works and were addressed by Mr George Elliott, vice-chairman of the shop stewards' committee. The meeting decided to hold a demonstration in London two days later, in which possibly 10,000 workers would march from Waterloo to Speakers' Corner, Hyde Park. At the Weybridge meeting Mr Elliott said: "We are meeting here in defence of our employment. If this country has to have military aircraft then we must be allowed to build them ourselves."

On the afternoon of **Wednesday, January 13,** the Minister of Defence, Mr Healey, met a deputation from the Society of British Aerospace Companies, at the Society's request, for talks on "matters of mutual concern." The SBAC representatives were Sir Arnold Hall of Hawker Siddeley; Sir Reginald Verdon Smith of BAC and Bristol Siddeley; Lord Caldecote of BAC; Mr E. C. Wheeldon of Westland, president of the SBAC; Mr C. E. Wrangham of Short Brothers and Harland; Sir Denning Pearson of Rolls-Royce; and Mr E. C. Bowyer, director and chief executive of the SBAC. The talks were "very useful," an MoD spokesman said afterwards.

In the monthly staff mess at the BAC factory in Weybridge, Sir George Edwards took time off from weightier matters to present prizes at the apprentices' annual prizegiving. In his address he said: "I don't believe that this country will take any step which would deprive itself of an aircraft industry capable of producing its own defensive devices and developing healthy exports."

Constitutency concern was passed on to the Government by Mr Peter Mahon, MP for Preston South; and by Mr Maurice Edelman, MP for Coventry North. Mass meetings were held by BAC workers employed in the Preston area and by Hawker-Blackburn employees at Kingston.

"Will personnel from the British Aircraft Corporation and Hawker Aircraft please move towards the exits . . ." The polite monotone of the station announcer at Waterloo on the morning of **Thursday, January 14,** formed a bizarre preliminary to a march by several thousand aircraft workers from the station to Hyde Park. BAC men from Weybridge, Hurn, Preston, Stevenage, Luton and Bristol were joined by others from Hawker Siddeley at Kingston and Coventry and from a number of TSR.2 subcontractors. The total number involved was estimated at between 4,000 and 8,000.

At Speakers' Corner the men were addressed by trade union representatives. A resolution was approved unanimously "that the British aircraft workers demand a national plan for the industry and to this end demand that there shall be no reduction in orders already placed or major displacement of personnel until alternatives are developed."

Following the Hyde Park demonstration, deputations from Preston and Weybridge went to the Ministry of Aviation for a meeting with Mr John Stonehouse, Parliamentary Secretary to the Ministry, and the Minister himself. Industry representatives also called at No 10 Downing Street and left a message for Mr Wilson.

That morning's *Daily Telegraph* had stated that Government plans to nationalize the aircraft industry "are well advanced." Mr George Brown, Minister for Economic Affairs, confirmed on returning to London Airport from Sweden that the Government had no intention of nationalizing the industry. Mr Jo Grimond, leader of the Liberal Party, suggested that proposals for rationalising aircraft production and civil aircraft procurement based on a European "home market" should be made jointly by Britain and the Common Market countries. It was reported on good authority that the cost of the full TSR.2 programme would be at least £750m.

Discussions on **Friday, January 15,** included two Cabinet sessions at No 10, with the Minister of Aviation present at both and the Service Chiefs of Staff attending one. Mr Wilson then drove to Chequers where he had invited five industry leaders to join him and Mr Jenkins for dinner and talks on the industry's future. Those invited were Sir Arnold Hall, Sir George Edwards, Sir Reginald Verdon Smith, Sir Denning Pearson and, a late addition, Mr C. E. Wrangham. The dinner party began at about 7.30 and continued until midnight.

Although most of the January 14 marchers were from BAC, Hawker Siddeley was also much in evidence

Straight and Level

AT Strasbourg in July 1964 the Council of Europe took no positive action on a report which recommended European governments to accept the principle of a supersonic surcharge. The Ministry of Aviation thought it best to wait and see.

It would—it has a vested interest in the Concorde. But it also has a vested interest in the protection of the airlines' investment in subsonic jets; in the long life of Super VC10 subsonic jet assembly lines; in a stretched-out supersonic airliner programme; and last but first, in the welfare of the travelling public.

A two-speed air fare structure decided *now* for the supersonic seventies will achieve all that.

● "The United States observer appointed to the Italian commission of inquiry into the recent take-off accident at Rome is Mr Martin V. Clark."—US *Aviation Daily*.

A routine matter, you might think—a representative of the State in which a crashed aircraft is registered automatically has a right to a place on a foreign accident commission. Yet it is not so.

There was no British representative on the Italian team which investigated the Viterbo Comet accident. There was no British representative on the French team which investigated the last Pyrenees DC-3 crash. Why not? Because, the Ministry said, they were not invited.

I can imagine the American FAA waiting to be invited to be represented on the Rome crash commission. I think the Ministry's safety people may be too gentlemanly sometimes, especially as 70 per cent of British accidents will statistically be investigated by foreigners.

I am glad to see that ICAO is trying to get agreement to give the State of Registry's representative a rightful place in other countries' accident investigations.

● The British aircraft industry has one purpose, and one purpose only. This is to provide employment for TV experts.

My favourite telepundit is shy, attractive, cigar-smoking Angela Knockering. She is so pretty, and I am so susceptible, that I sometimes find it hard to concentrate on what she is saying.

However, I get the message. The TSR.2 is absolutely USELESS, and the Concorde is even more absolutely useless.

Well, the aircraft industry has its share of nits, and so has the Government, and so has every other section of society. Call me a nit if you like. But I simply do not believe that the aircraft industry—as the Knockering school of telepundits would have us believe—is so completely populated and managed by nits.

● A year ago it would have been difficult to find a man more implacably opposed to British United Airways than Lord Douglas, then chairman of BEA. But anything can happen in aviation. "I am sure," says Lord Douglas, now chairman of Horizon Holidays, "our many friends in the travel business will be interested to know that both Horizon and Streamline programmes for 1965 will make extensive use of the BAC One-Eleven jet. We have, in fact, more flights with British United Airways than any other inclusive holiday company."

● I trust Lord Douglas will at least put a stop to British United's misuse of the mother tongue:—

"BUA have agreed," says a staff notice, "to provide all necessary training activities for Gambian staff with a view to the early Gambianisation of the company . . ."

● From *Hansard*:—

Mr Cranley Onslow asked the Joint Under-Secretary of State for Education and Science, as representing the Minister of Technology, if his Department will, in conjunction with the Ministry of Aviation, set up an inter-departmental inquiry into the technological loss to British industry that would result from the cancellation or reduction of the Concorde and TSR.2 projects; and if he will publish its findings as a White Paper.

Mr Stonehouse: No.

● How do you replace a chief designer who is retiring, or just perhaps tiring? Do you promote the assistant chief designer?

Never do this. A chief designer's job is to have his feet always just a little off the ground. When a new project is launched, he makes ten basic decisions about it, and then thinks creative thoughts about the next development.

The assistant chief designer's job is to keep the chief designer under control, to keep his feet firmly on the ground. He has to be the realist, the positive, practical engineer. And I doubt whether the realistic, steady designer with his feet firmly on the ground makes the best chief designer.

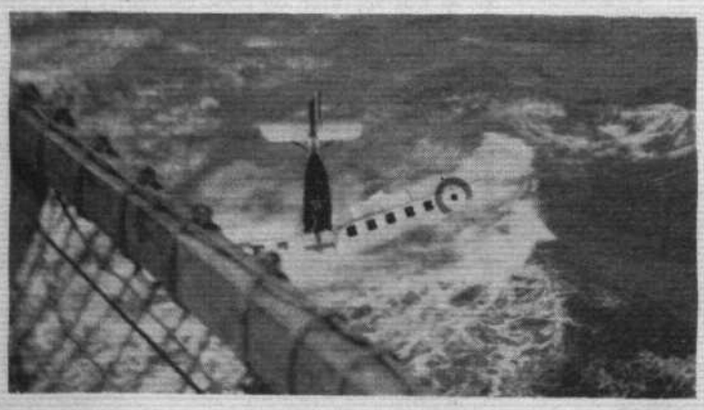
A firm with a chief designer who fusses about details like the servo tab mechanism is heading for trouble.

● FOUR PLANE CHIEFS FOR CHEQUERS DINNER

—*The Daily Telegraph*, January 13

ROGER BACON

Are you . . .



. . . all right? (Nos 47 and 48)

Above, a D.H.9A which nearly went over the side of one of His Majesty's carriers in the 'thirties. Nobody hurt. Below, a Fairey IIIF of 824 Sqn ditches alongside HMS "Eagle" in about 1934. Both crew members were fished out unharmed, but the IIIF sank

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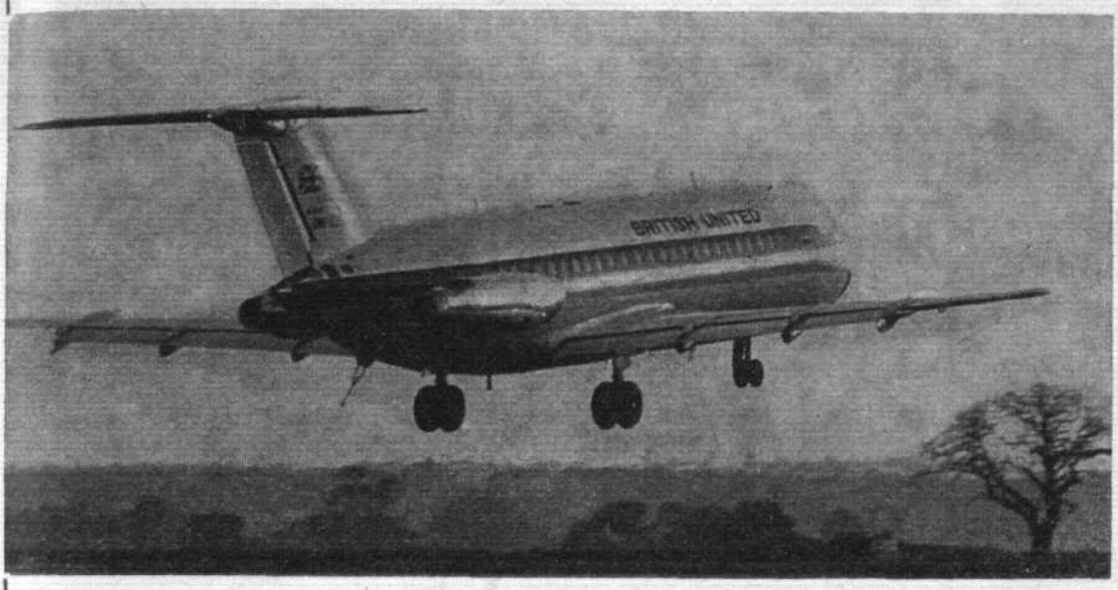

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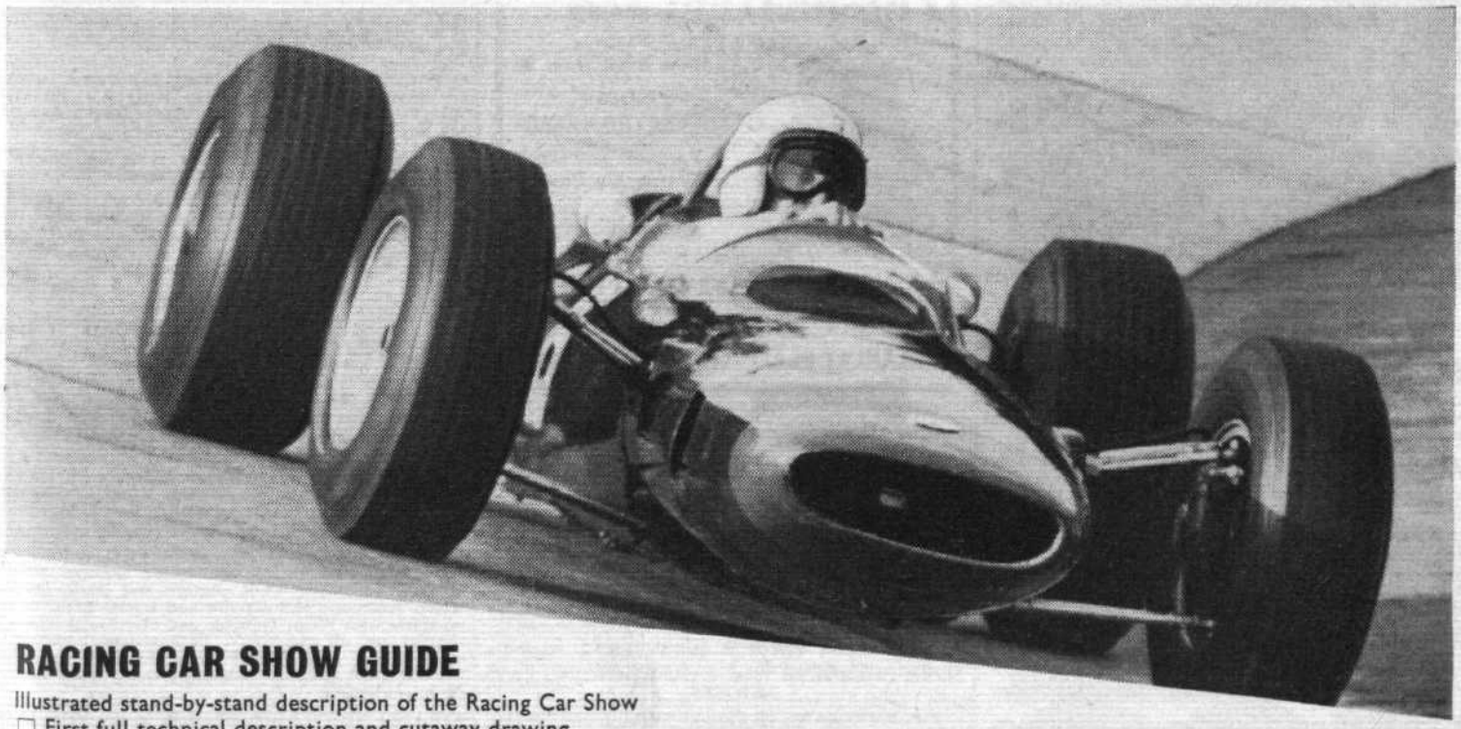

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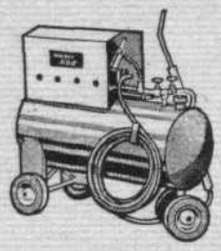

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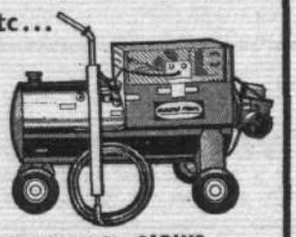

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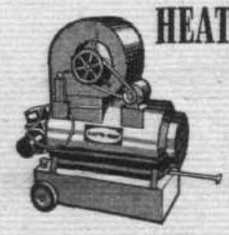

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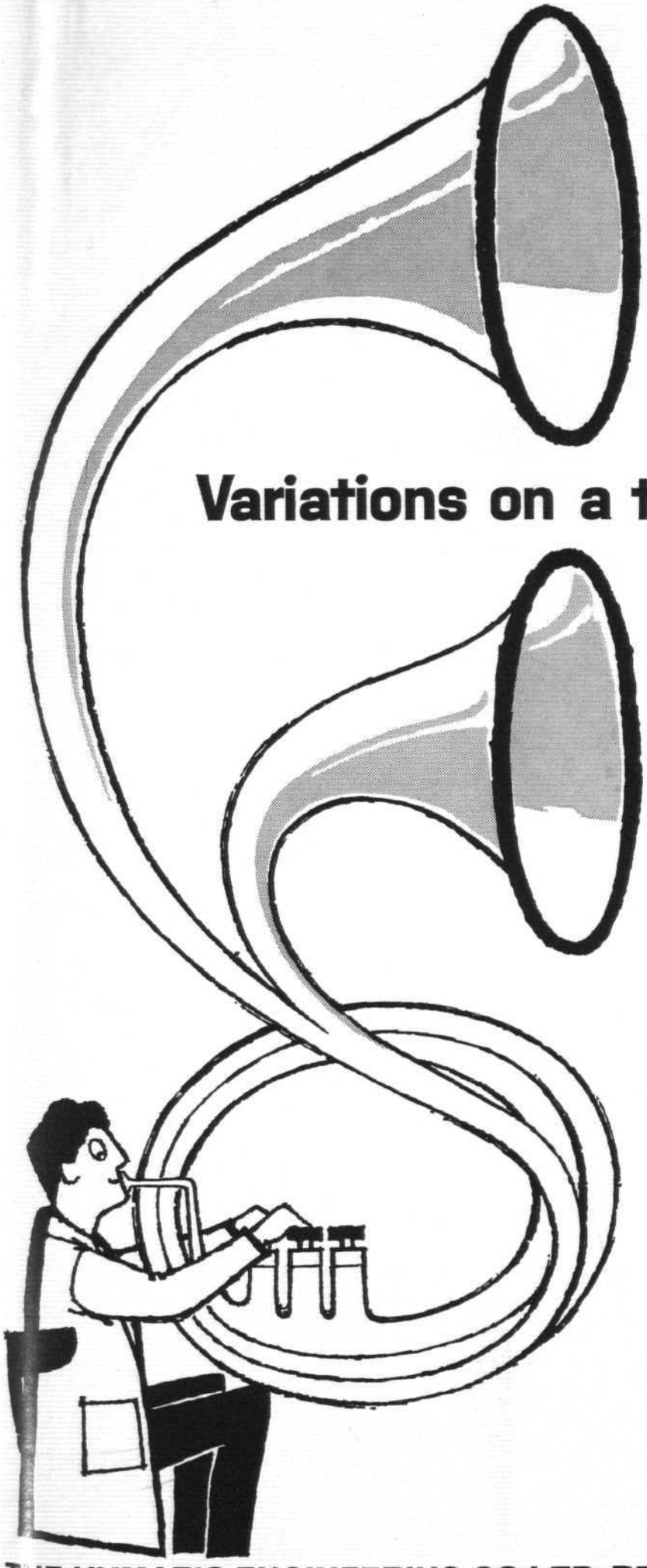

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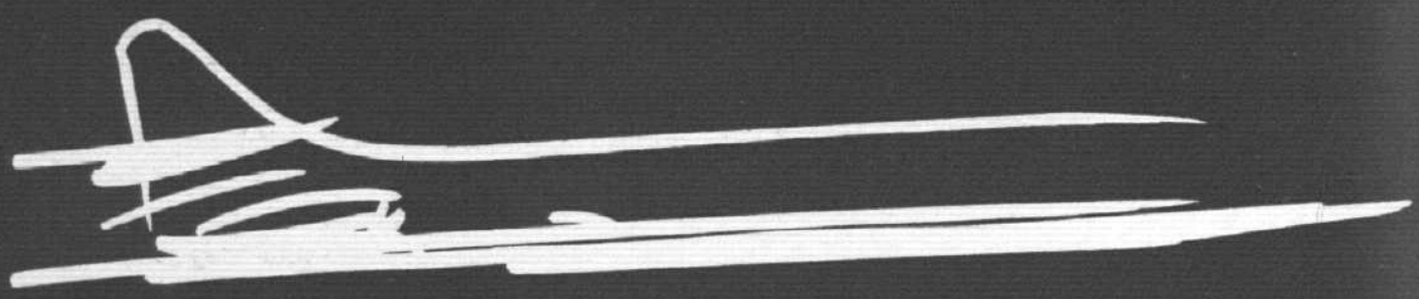

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