

THURSDAY 2 FEBRUARY 1967

Number 3021 Volume 91

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Iliffe Transport Publications Ltd, Dorset House, Stamford Street, London, SE1; telephone Waterloo 3333 (STD.01). Telegrams/Telex: Flight Iliffe, 25137 London. Annual subscriptions; Home £6. Overseas £6 for one year; £12 for three years. Canada and USA \$18 for one year; \$36 for three years. Second Class Mail privileges authorised at New York, NY.

Branch Offices: Coventry, 8-10 Corporation Street; telephone Coventry 25210. Birmingham, 401 Lynton House, Walsall Road, Birmingham 22b; telephone 021 BIRchfield 4838. Manchester, 260 Deansgate, Manchester 3; telephone Blackfriars 4412 or Deansgate 3595. Glasgow, 123 Hope Street, Glasgow C2; telephone Central 1265-6. Bristol, 11 Marsh Street, Bristol 1; telephone Bristol 21491-2.

New York, NY: Thomas Skinner & Co (Publishers) Ltd, 300 East 42nd Street, New York 10017, USA; telephone 867-3900.

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## Getting AFVG Collaboration Right

**E**UROPEAN collaboration means giving some things away, but we wonder whether Britain is not following too scrupulously St Paul's dictum that it is better to give than to receive. Britain will not, it is learned, have design leadership of the AFVG; yet this is a point on which there should surely be no dispute.

For historical reasons France (Breguet) are design leaders on the Jaguar airframe. France, too, has a 60/40 share of the Concorde airframe in return for Britain's 60/40 share of the Olympus, though Britain's possession of an engine should have been a mighty bargaining plus, not a minus. Britain is contributing and paying for the Olympus Vulcan, the BAC-221 and the HP.115 on her own account, and has conceded the prestige of the first flight of the first prototype Concorde to France and a French crew.

The helicopter deal is most welcome, but the SA.340 and the SA.330 will be, or are, of French design and it seems that these machines will not be fitted with British engines or anglicised to any degree for the RAF and the British Army. In return Britain will be design leader of the WG.13—though Westland will share the design with Sud, and there is as yet no agreement that the engine will be British.

We are not among those who say that France is advancing her technology at Britain's expense, but we do wonder why the balance of advantage in the co-operative agreements to date has been allowed to lie so heavily with the French.

## Does it Matter?

Perhaps possession of design leadership does not really matter? It does not affect the 50/50 share of design work. In any case it is not in the national character for Britain to feel she has to assert her sovereignty. But this is more than a matter of appearances. New technology inevitably involves difficult judgments, and these can cause enough trouble without the intrusion of national sovereignty, especially when this is manifest by a firm with the Mirage-building superiority complex of Dassault.

Both sides ought to know that if ever they come to drawing swords over a technical dispute, there is someone who will say "it will be thus." This means in practice that swords remain sheathed. Authority may never in fact have to be exerted: it never has been on the Jaguar. Its very existence deters conflict. On the Concorde, incidentally, design leadership is French, and there have been no serious tantrums.

Now being worked out for the AFVG is a system of shared design leadership whereby disputes go to a joint technical committee. This sounds all right in theory, and it has worked satisfactorily on the Hawker Siddeley/Engins Matra Martel missile. But on the AFVG—the first major project to be purely Anglo-French in origin—shared leadership could accentuate the incidence of disagreements by blurring technical responsibility, especially with Dassault's nearly completed v-g Mirage IIIG in the background.

Not until sovereignty has been purged from Europe, which may be some time yet, can there be two master-minds on new projects involving collaboration in advanced technology. Such collaboration requires clearly defined leadership, and reciprocity requires that Britain should lead on the AFVG.





# WORLD NEWS

## Tragedy at the Cape

Apollo astronauts Virgil Grissom, Edward White and Roger Chaffee were burned to death in their spacecraft at Cape Kennedy on January 27 during a practice countdown in preparation for the Apollo 1 flight, which had been scheduled for February 21. According to Maj-Gen Samuel Phillips, Apollo programme director, "A flash fire originated inside the capsule and surrounded it for a matter of split-seconds." A fuller report is on page 181.

## US Budget: Big Aircraft Purchases

Tactical - aircraft purchases figure largely in the 1967-68 US defence budget presented last week (see page 180), and in the 1967 supplemental appropriations revealed simultaneously. Extra purchases of F-111A and -B fighters account for \$989 million and \$251 million respectively, while the first purchase of the FB-111 strategic bomber variant requires \$502 million. The United States Navy is getting \$551 million for A-7 Corsairs, while the USAF receives \$356 million for its Spey-engined -D variant. More A-6 Intruders for the USN will cost \$151 million. Further purchases of USAF and USN Phantoms, in strike and reconnaissance configurations, will cost \$1,820 million. Another \$423 million is earmarked for the C-5A transport. Lockheed's Mach 3 F-12 fighter project is to be financed only with the remainder of a \$55 million vote passed last year and only \$26 million is provided for further work on the advanced manned strategic aircraft (AMSA) project.

The 1968 programme provides for an active all-Services inventory of 34,468 aircraft, including 11,132 helicopters—an overall increase of 2,158 aircraft. The helicopter total will be 2,200 higher.

## McDonnell Douglas Details

The merger of Douglas Aircraft Co and the McDonnell Company into the McDonnell Douglas Corporation is expected to be completed by April 30. The new corporation will have its headquarters in St Louis, with the McDonnell Co and Douglas Aircraft operating separately as its principal components.

Donald W. Douglas will be honorary chairman of the board of the McDonnell Douglas Corporation. James S. McDonnell will be chairman and chief executive officer and David S. Lewis will be president.

At Douglas Aircraft, Donald W. Douglas will be designated founder-consultant, David S. Lewis will be chairman and chief executive officer, and Donald W. Douglas Jr will continue as president.

Additional terms for the proposed merger were announced on January 25,

and Douglas and McDonnell shareholders will vote on the proposal later.

(On January 23 Douglas Aircraft Co reported a net loss of \$27,560,000 for the fiscal year ended November 30, 1966, compared with net earnings of \$14,598,000 for fiscal 1965. Sales for fiscal 1966 were \$1,048,011,000 the highest since 1960, compared with \$766,790,000 in 1965. Backlog at November 30, 1966, was \$3,274,511,000. Commercial orders accounted for \$2,585,654,000 or 79 per cent of the backlog, and government work totalled \$688,857,000 or 21 per cent.)

## £2 million Loan for Shorts

In a written parliamentary answer on January 26, the Minister of Aviation, Mr John Stonchouse, announced that the Government had decided that the advance of £510,000 to Short Bros & Harland (announced on December 21) "shall be part of a loan of up to £2,150,000 to enable the company to maintain their present programme."

The terms of the loan are now being negotiated, and payments "will be made as necessary to meet the company's current needs."

## Reducing Belfast Drag

The Belfast drag-reduction programme, consisting mainly of fitting strakes under the rear fuselage, has now been completed, and MoA final performance trials are under way at Boscombe Down. They will last several weeks, but already there are indications that the lost performance will be substantially restored.

## Do31 Hover Rig Airborne

The Dornier 31 VTOL hover rig made its first flight at Munich-Oberpfaffen on January 25. Powered by two Bristol Siddeley 5s and two banks of four Rolls-Royce RB.162 lift engines, it is known as "the big hover rig" to distinguish it from the earlier, tethered Dornier rig with RB.108 lift engines.

Meanwhile, the Do31-E1 VTOL research aircraft should fly within a few

weeks. This aircraft, rolled out on November 30, 1965, will fly without its eight RB.162 lift engines, although it will retain the wing-tip nacelles.

There are no production plans for the Do31, and cuts called for by the recent West German defence budget may severely curtail the programme.

## DoD Supports Martin-Baker

The US Department of Defence, together with British officials, has strongly defended the Martin-Baker ejection seat against an attack by the American General Accounting Office, which acts in a watchdog capacity over Government expenditure. The office alleged that the Government had made a major error in purchasing the seats, which, it claimed, were more expensive than comparable American seats and less safe.

Replying to complaints that the US Services spent an extra \$4,400,000 in buying the Martin-Baker seat, the Defence Department said "the Martin-Baker seat was selected because it possessed safety features which made it superior to the domestically produced F-105 seat." There would have been a net increase in costs of \$511,000 (£184,000) rather than a saving of \$4,400,000 (£1.58 million) had the F-105 (Republic) seat been selected.

The net increase takes into account the cost of changing the seats and more expensive maintenance for the American model. Referring to the accident rate, the General Accounting Office produced figures claiming that whereas nine out of 51 US Navy F-4B Phantom pilots using the British seat had died, the proportion for those using the American seat was only two out of 49.

A spokesman for Martin-Baker said that the claims made by the General Accounting Office were ill founded. Compared with seats giving the same performance (he continued) the Martin-Baker seat was the cheapest in America and also had the highest safety record in the world.

**LOH cunning** The Sud SA.340 LOH (light observation helicopter), inclusion of which in the Anglo-French helicopter package deal was recorded in "Flight" last week, at present exists in mock-up form only. The design may undergo some changes as a result of its adoption by the British Army as a Sioux replacement in 1970





### TRACE for Pan American

An order from Pan American Airways for the Hawker Siddeley Dynamics TRACE (tape-controlled recording automatic check-out equipment) was announced last Monday, January 30. This important contract, the first from an American customer, is for the TRACE 600 (an improved version of the TRACE III), which will be used to check Boeing 707 autopilot systems at the airline's John F. Kennedy maintenance base. With present equipment such a check takes 18hr; the 600 can do the work in 1½hr. This is the fourth major TRACE contract signed within the past six months; others have been with BOAC, Alitalia, and RAF Transport Command, the first and third being repeat orders. A typical 600 installation costs about £100,000, and TRACE orders so far are valued at well over £500,000.

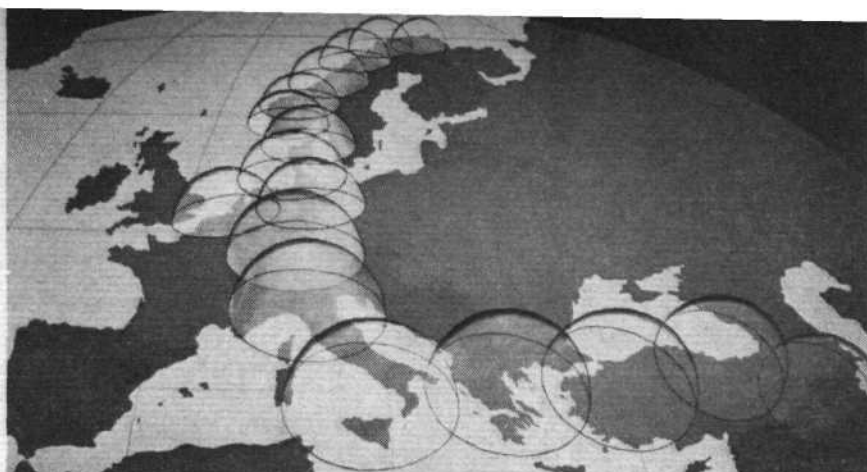
### Royal Aero Club Appointment

Mr Simon Ames, chief executive of the British Light Aviation Centre, has been appointed to the post of secretary-general of the Royal Aero Club. He succeeds Gp Cpt Norman Ryder, who resigned from the post last November.

### Lear Jet Financial Loss

In an interim report to shareholders Lear Jet Industries Inc report a loss of \$1.9 million (£680,000) on sales of \$19.9 million (£7.1 million) during the first half of the current financial year. The problem lies mainly with the Aircraft

Division. Reasons given for the sharp reversal of the group's aviation fortunes include disappointing sales caused by the pause in the growth rate of the American economy, and the expenses of introducing the Lear Jet Model 24. Business-jet production at Wichita has been cut to about one aircraft per month compared with the output of some six units per month a year ago. Though the Avionics Division results reflect the aircraft situation, the newly acquired Brantly Helicopter Division has "an all-time high" backlog of orders while the Stereo Division continues to flourish with its range of stereo tape and tape players for a mass market.



**Not igloos, but an impression of the NATO areas covered by the NADGE (NATO Air Defence Ground Environment) project. It covers the manufacture and installation of ground equipment which will greatly improve the ability of the present system to detect, identify and track aircraft. Contracts were formally awarded to nine nations at a ceremony on December 28; total cost will be about £110 million**

### Frank Smith Leaving RAeS

Mr F. H. Smith, librarian of the Royal Aeronautical Society, is leaving at the end of the month in order to take up an appointment with the British Transport Staff College. He has been with the RAeS for the past 17 years.

### Reserves Club Ball

On Thursday, March 9, the RAF Reserves Club is holding a ball at the London Hilton Hotel, in aid of its funds. Tickets—attendance is not confined to members and/or Service people—are obtainable at £3 5s each from the secretary-general of the club, at 14 South Street, Park Lane, London W1.

## SENSOR

**Rolls-Royce** are to launch their "advanced-technology" engine, and an announcement is expected shortly. It will be the Trent, smallest of the RB.178 family, revealed at Farnborough '66. This 9,730lb three-spooler has a by-pass ratio of 3.0 and has been selected by Fairchild for their FH-228, licence-built version (though smaller) of the Fokker F.28. Fairchild are to launch this new project shortly, for delivery in 1970, in a follow-up to the successful F.27 agreement, having dropped the FH-227 ("jet Friendship") project. The FH-228 will be a 50-seater weighing 54,000lb gross and with a field length of less than 4,000ft. The Trent will presumably be applicable to the F.28 also, though it will need a higher rating. There is in fact considerable growth in this engine, which could become as important as the Spey.

**The full-scale Concorde** mock-up to be shown at the Paris Salon will afterwards be exhibited throughout the summer in the City of London, on a site alongside St Paul's Cathedral.

**The Weather Minima Committee**, set up in September 1965, has now held about 45 meetings, with at least another dozen or so still to be held. The original brief of the committee was to consider if decisions should be transferred from the pilot to the air-

port; to examine existing rulings; and to look into the adequacy of methods of determining the actual minima. It is felt that, unless regulations are tightened up on a basis of operational research, the introduction of Category 2 minima could lead to an increase in accident rates.

**The Select Committee** on Nationalised Industries will begin an inquiry into BEA early next month. Sub-committee B will examine the corporation's 1965-66 report and accounts, covering all aspects of BEA operations. Meanwhile Sub-committee A is examining the nationalised industries in general, including both BEA and BOAC. The reports and evidence will, subject to the routine limitations, be published in due course.

**A new lightweight airborne computer** is shortly to be announced by Marconi. Suitability for an unusually wide range of tasks will be claimed with application to the Jaguar and AFVG principally in mind.

**The RAF** has never favoured arming helicopters for offensive use but the Army is now pressing for heavily armed helicopters to provide intimate fire support in the Vietnam style. The RAF is co-operating with the Army in studies of the sort of operations that British forces might be required to stage, but it is not yet convinced that the very extravagant US heli-

copter techniques are applicable and is considering fixed-wing ways of providing intimate and accurate ground fire, perhaps by aircraft such as the Jet Provost. In any event a new military air operational requirement is shaping up.

**The forthcoming transfer** of HDL's hovercraft research establishment to the NPL is only part of a shake-up in the entire British ACV field. The virtual refusal of the NRDC to grant new licences to British companies, which has been in effect for about two years, is now weakening—both Hovermarine and Vosper-Thornycroft announcements are imminent. Interests behind Hovermarine include City commodity brokers C. Czarnikow Ltd. Implications of the new ACV arrangements will be discussed in our next Air-Cushion Vehicles supplement on February 23.

**Trident 3 deliveries** to BEA will enable services to start in April 1969 and the fleet will be up to 70 per cent strength by April 1970 and 100 per cent by April 1971. The BAC One-Eleven 500 fleet will be at 80 per cent strength by April 1969. Boeing had promised 100 per cent deliveries of 727s and 737s by April 1969.

**The annual reports** of the British Airports Authority, the first of which is due out in about six months' time (for the year ending March 31, 1967), are likely to be the most comprehensive published by any airport authority.



## Parliament

KENNETH OWEN

This week the Select Committee on Science and Technology is holding its first meeting. The 14 members of the new committee were named last week: they include Mr Eric Lubbock and Mr Robert Howarth (recent guest contributors to this column); Mr Stephen Hastings, author of *The Murder of TSR.2*; and Sir Ian Orr-Ewing. In these four members at least the committee has a sound basis of aviation interest and knowledge.

On Tuesday and Wednesday of this week the Lords and Commons in turn were to debate the Ministry of Aviation (Dissolution) Order 1967, after which each House was to present "an address to Her Majesty praying that the Order be made." In pursuance of Section 1 of the Ministers of the Crown (Transfer of Functions) Act 1946 and with the advice of Her Privy Council, Her Majesty will then doubtless be pleased to order accordingly. Complicated, traditional, but it works.

The wording of the Order, also, is worthy of note. "Whereas," it begins, "it is expedient that the functions of the Minister of Aviation be transferred to

the Minister of Technology . . ." (a question-begging and expedient assumption, to say the least). ". . . The functions of the Minister of Aviation are hereby transferred to the Minister of Technology, and the Ministry of Aviation is hereby dissolved."

So far so good, but Section 4 (2) goes on to separate the men from the boys. "Any authority, appointment, approval, direction, byelaw or licence given or made or other thing done," it affirms, "or having effect as if given, made or done" it adds, "by the Minister of Aviation in the exercise of any function transferred by this Order shall, if in force at the coming into operation of this Order, continue in force and have effect as if given, made or done by the Minister of Technology." In other words, it's all yours, Mr Benn. But not until February 15.

On January 23 Mr Neil Marten (Conservative, Banbury) asked for details of the Anglo-French helicopter agreement. In a written answer Mr John Stonehouse, Minister of Aviation, stated that development of the SA.330 was already well advanced and would continue to be undertaken and financed primarily by France. Development of the other two helicopters would be shared and financed equally, with France having the design leadership on the SA.340 and Britain on the WG.13.

Production would be organised so that duplication of tooling was kept to a minimum, and in each case would be divided to give each country work equivalent to its national requirement and an equitable share of exports. On the two jointly developed helicopters

exports would be shared 50-50; on the SA.330, where France had borne the major share of development and had the major requirement, the British export share would be less.

Mr Stonehouse confirmed that the initial British order for the SA.330 would be for about 50, and that orders for the two smaller helicopters were likely to be "substantial."

Among other aviation business last week the subject of Tees-side Airport was raised on the adjournment on January 24—at 12.05 a.m. on January 25, to be precise—by Mr Ted Fletcher (Labour, Darlington). Mr Fletcher, Mr Timothy Kitson (Conservative, Richmond, Yorks) and Mr James Timmins (Labour, Cleveland) were concerned at Autair's decision to operate the Tees-side/London service to Luton and not Heathrow; for the Board of Trade, Mr J. P. W. Mallalieu (who recently replaced Mr Roy Mason as a Minister of State) was sympathetic but non-committal (see also page 157).

Finally, Mr John Wells (Conservative, Maidstone) has been asking Ministers what economies they have made in their Departments on hospitality and official entertainment, and on January 25 Mr Stonehouse replied for his Ministry of Aviation. "Expenditure on hospitality and official entertainment," he declared, "has been and will continue to be strictly controlled and administered with the greatest economy."

And quite right, too. But thanks anyway for a good party that same night, Mr Stonehouse. Even administered with the greatest economy, the Twiglets were delicious.

## Explorers

ROBERT BLACKBURN

Three fine men died last Friday at Cape Kennedy. Our tribute to Grissom, White and Chaffee must be no less a tribute to the other astronauts who will take their place. It is timely to think of the astronauts—and the cosmonauts—who survived the previous space missions; of those who will survive future missions; and of those who will not survive. They are all of a kind, and there is no just way to distinguish between them. As a group these are exceptional people—healthy, intelligent, skilled and courageous. These first spacemen are prominent among the great explorers of our twentieth century. Unlike all great explorers of past ages, they do not want for earthly backing nor are they uncertain of the nature of this planet; there are no worries in space travellers' minds about the dangers of oceans, swamps, jungles, mountains or unfriendly natives. The exploration is so vast an undertaking that it could be contemplated only by two mighty industrial powers. Our own British nation, for all its history of exploration, is now confined to observation. Let us

at least observe acutely, with our minds as well as our radio telescopes.

The astronauts and cosmonauts are the first people to see the world as a whole. Perhaps the world will view them with equal breadth of vision. A man in weightless orbit around the earth is a human being first and an American or Russian second.

As it happens, the first known major accident to a spacecraft occurred on an American launching pad, and not in space. Whether or not the world would know of a similar accident on a Russian pad—or whether such an accident has already happened—is naturally open to doubt. But if the accident had occurred in space, the tragedy would have been seen and felt in universal rather than in national terms. Last Friday's accident, I fear, will be seen as a loss to America more than to mankind. Grissom, White and Chaffee might have been the first men on the Moon, and I am sorry that now they cannot be. For their epitaph I propose these lines from John Donne: "Any man's death diminishes me, because I am involved in mankind; and therefore never send to know for whom the bell tolls; it tolls for thee."

For their memorial I would like to see an agreement between America and Russia, on behalf of us all, to place upon the surface of the Moon neither the Stars and Stripes nor the Hammer

and Sickle—whichever spacemen reach its surface first—but the olive branch of the United Nations.

Sometimes explorers are lost, but without explorers we are all lost. Rarely does the successful explorer reap the harvest of his discoveries; rarely does he have a complete grasp of their implications. The astronauts and the cosmonauts may appear to be above-average airmen aspiring to the highest professional ranking in their chosen field; probably this is how, in the main, they see themselves.

To my mind they are more. They are the spearhead of the greatest challenge yet faced, and grasped, by man—the challenge of leaving the security of his own planet to see it from space and to begin—just begin—to learn the nature of the Universe from first-hand experience of outer space.

It is easy to say that space exploration is a waste of money and that it promises no tangible return, that the money should be spent instead on cancer research and other important social purposes. It is difficult to prove that space exploration is necessary and that its findings may indeed contribute to cancer research and other important social purposes. It is still more difficult, skipping the arguments and the philosophical discussions, to put on a space suit, board a spacecraft, and simply go out there looking for the answers.

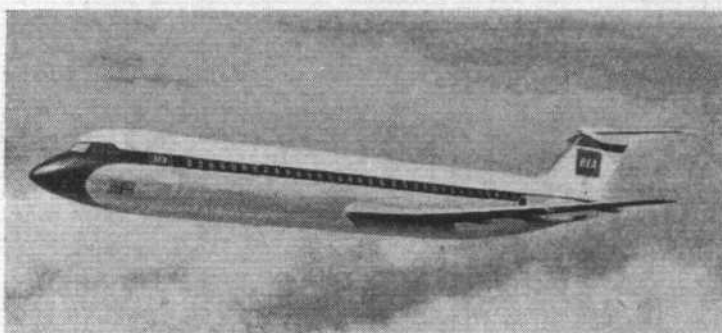




# AIR TRANSPORT

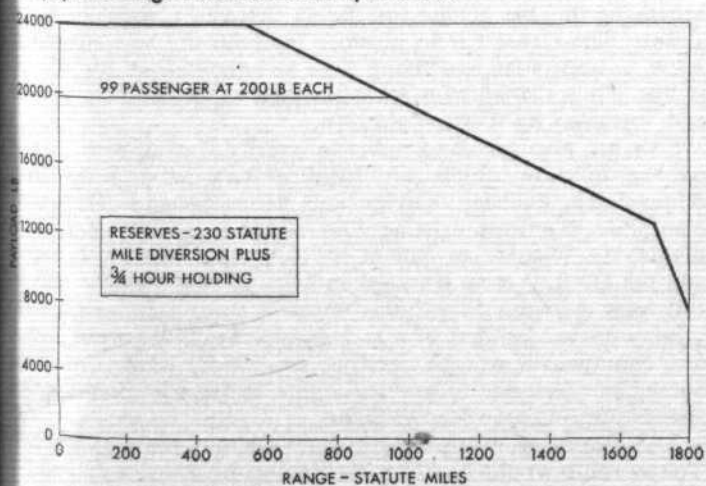
## BEA's One-Eleven 500s

In a statement made when the contract was signed last Friday, Sir Anthony Milward, BEA's chairman, said: "Some two to three years ago when I was asked would BEA be ordering the new BAC One-Eleven I replied quite firmly that



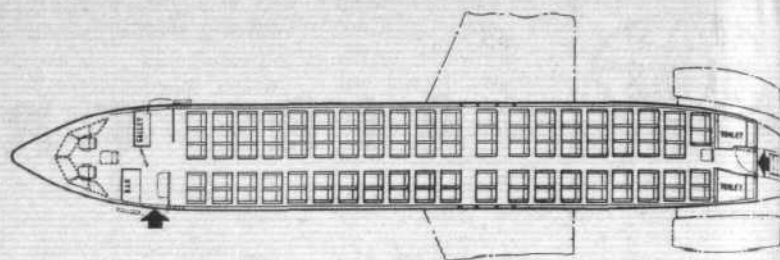
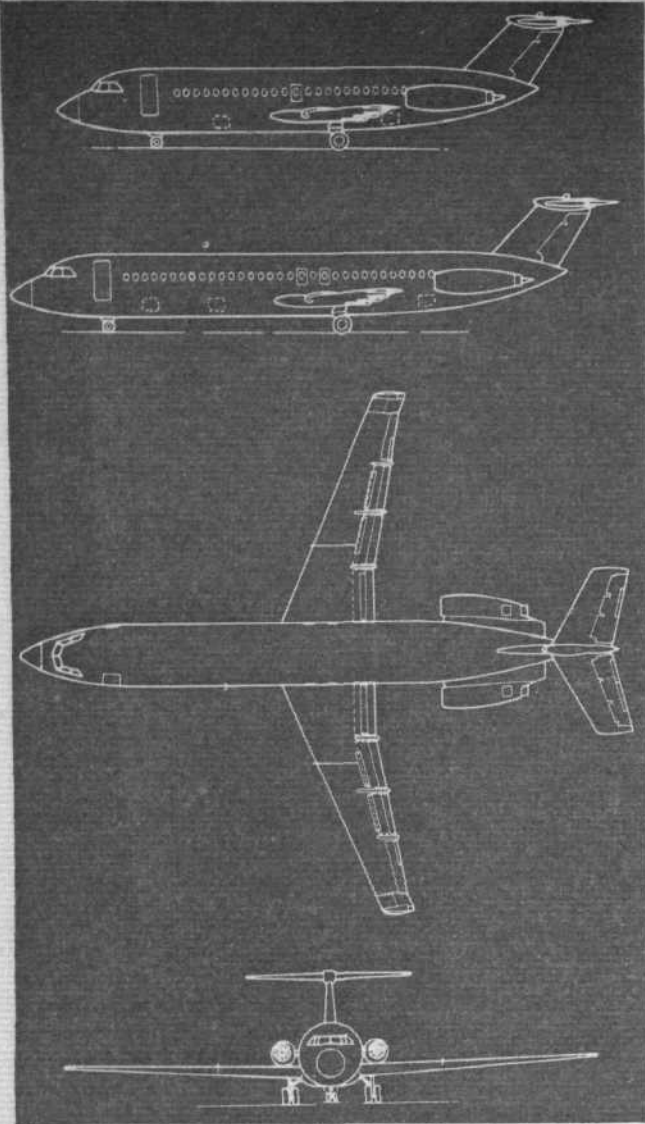
*How the One-Eleven 500 will appear in BEA colours*

Sir George Edwards, managing director of BAC, said: "We in BAC—having, either as BAC or as Vickers, evolved three aeroplanes in conjunction with BEA (the Viking, Viscount and Vanguard)—are obviously glad to be back with 'the old firm' on a fourth aeroplane, the 500 Series One-Eleven, which I



	500 Series	400 Series
Powerplant ... ..	2 x 12,000lb-thrust Rolls-Royce Spey 25 Mk 512-14	2 x 11,400lb-thrust Rolls-Royce Spey 25 Mk 511-14
Fuel capacity ... ..	3,100 Imp gal	3,100 Imp gal
Overall length ... ..	107ft	93ft 6in
Fuselage length ... ..	97ft 4in	83ft 10in
Wing span ... ..	93ft 6in	88ft 6in
Overall height ... ..	24ft 6in	24ft 6in
Gross weight ... ..	91,000lb	87,000lb
Max landing weight ... ..	84,000lb	78,000lb
Zero fuel weight ... ..	78,000lb	71,000lb
Payload (volume limited) ... ..	24,000lb	18,375lb
Seating capacity (all-tourist) ... ..	99	79
Seat pitch ... ..	34in	33in
Hold capacity: forward ... ..	516 cu ft	354 cu ft
aft ... ..	260 cu ft	180 cu ft
Max cruising speed ... ..	Mach 0.78 at 24,000ft (550 m.p.h.)	
Take-off field length (gross weight, ISA, sea level) ... ..	7,350ft	7,850ft
Landing field length (max landing weight, sea level) ... ..	5,120ft	4,880ft
Maximum payload (passengers); for range (incl reserves) ... ..	19,800lb 950 miles	15,800lb; 1,580 miles
Full tanks range (incl reserves) ... ..	1,650 miles	1,840 miles





The general-arrangement drawing of the One-Eleven 500 also shows at the top, for comparison, the 400 series. Above is a typical passenger arrangement for the 500—with 99 seats at 34in pitch

## AIR TRANSPORT . . .

believe will prove to be an efficient and economic vehicle, well suited to their routes.

"It is worth recording that, at the time BEA made their original evaluation of British and American aircraft, this version was not available to them and was not included in their assessment. Subsequent discussion with BEA led to this version of the One-Eleven as an aircraft well suited to their operation, as has happened before—notably in the case of the 800 Series development of the Viscount.

"We have already achieved export success with the One-Eleven in its present size. The new 500 Series will not only provide an additional export market in its own right but, we believe, will be helpful in encouraging prospective purchasers of the 200/300/400 Series who wish to see the ability to operate larger aircraft of the same basic type to meet their growing traffic."

## AIRBUS REVIVAL

MINISTERS responsible for civil aviation in Britain, France and West Germany met in Bonn on January 27 to discuss the possibility of co-operation on the airbus project. West Germany's Economics Minister, Prof Karl Schiller, was host to Mr John Stonehouse, British Minister of Aviation, and M Edgar Pisani, the French Minister of Transport. Hopes of reviving interest in the somewhat amorphous airbus project are said to have been revived by German concern for a share in the European aircraft industry.

After a six-hour meeting, the Ministers referred four basic questions to a working group which is charged with reporting back within one month. The points are: the needs and procurement intentions of airlines; the extent of financial participation by industry; the extent of governmental financial participation; the choice of engines. A further meeting of Ministers is planned for mid-March to draft a report for

submission to the three governments. Present European philosophy is said to be hovering around a 270-seat twin-engined airbus with a range of 1,200 n.m.

Whether airlines are prepared to state requirements for such a project is, at this stage, uncertain—and so is the source of finance. BEA, Air France and Lufthansa representatives are due to meet in Paris tomorrow (February 3) to have further discussions on the type of aircraft, capacity and date of introduction into service—if indeed any of them feels able to make firm predictions.

## TOKYO-MOSCOW PLANS

THE joint Aeroflot/Japan Air Lines service between Tokyo and Moscow (see *Flight* for January 26, page 117) will start on April 17 to provide the shortest-distance service between Europe and the Far East. Initially all the flights will be operated by Aeroflot with Tu-114s which will carry the insignia of both airlines. There will be a flight crew of six—five from Aeroflot and one JAL adviser—and a cabin staff of ten including three stewardesses from each airline. Accommodation will be for 72 economy class and 44 first-class passengers. In two years' time JAL will start operating on alternate services. The initial frequency will be once weekly in each direction. The flying time will be 11hr 50min westbound and 10hr 50min eastbound. The present flying time between the two points is more than 19hr.

The commercial agreement signed on January 20 consists of a three-party lease contract between the two airlines and the Soviet Government, and two-party commercial and sales contracts between the two airlines. The agreement is based on the civil air agreement between the two governments which was signed on January 21 last year.

## SAS ACROSS SIBERIA

FOLLOWING the agreement with JAL (see above) an "air political agreement" between Scandinavia and the Soviet Union was signed on January 27. It gives SAS the automatic right, as soon as international air corridors across Siberia are established, to use the routes for flights between Copenhagen and Tokyo. The Great Circle distance between the two capitals is 5,460 statute miles and flying time is estimated at 10½hr. This is the first trans-Siberian air agreement to provide for end-to-end operation by Western aircraft.

SAS has also obtained rights to overfly Russia, with a landing at Moscow, Tiflis or Tashkent, on services to Iran, Afghanistan, Pakistan, Ceylon and points beyond. The agreement, too, confirms existing SAS rights to overfly Russia on flights via Warsaw to points in Rumania, Turkey, Lebanon and the UAR. A new Russo-Scandinavian route will be opened this year between Stockholm, Oslo, Copenhagen and Leningrad, with an optional stop at Helsinki. Traffic between Russia and Scandinavia will be operated on a pool basis. Under the agreement Aeroflot is granted rights to overfly Scandinavian territory on intercontinental flights.

SAS president Mr Karl Nilsson said that the Copenhagen-Tokyo route would be flown by SAS within two years and the Asian route within one.



## BUAF Cuts its Losses

**S** EVEN LONG-HAUL vehicle-ferry services, four of them deep-penetration operations into Europe, are being withdrawn by British United Air Ferries from February 28. They are: Manchester-Rotterdam; Coventry-Calais; Lydd/London (Gatwick)-Basle; Lydd/London (Gatwick)-Geneva; Southend-Basle; Southend-Geneva; and London (Gatwick)-Le Touquet. Explaining the decision, Mr Max Stuart-Shaw, managing director of British United, said that BUAF had been forced to take this step because of the severe losses suffered for a number of years on the long-range vehicle-ferry services—"losses which would have undoubtedly continued. . . ." The services being withdrawn, he said, "are those which we operate only at a comparatively low frequency—we are, in fact, withdrawing seven flights each day out of a high-season daily total of 85. . . . We will, of course, do everything we can to help those who have already booked with us to make alternative arrangements. In terms of round trips, about 600 vehicles and 1,600 individual passengers had been booked on the cancelled services."

Mr Stuart-Shaw said later that the sea-going ferries were "cheap and good." He added that there had been a tremendous increase in competition from the sea ferries and that soon there would be hovercraft and the Channel tunnel. He hoped, however, that "with a little surgery" BUAF could now make the air-ferry services pay their way.

This is the end of BUAF's bold experiment, started in 1962, to recapture car-ferry business being lost to the ships. The plan was to leapfrog them with the Carvair—Mr Freddie Laker's then brilliant idea for a relatively cheap and proven replacement for the superannuated Super Bristol Freighter. Surface car-ferry competition tolled the knell of Silver City and drove it into the arms of its erstwhile rival BUAF (*née* Air Charter, later Channel Air Bridge) and the new "deep-penetration" Carvair services began with high hopes in 1962, with routes from Southend to Basle and Geneva and ambitious plans for new destinations in the future.

Such is the secrecy surrounding the public air transport operations of Britain's independents that there has never been any indication of the severe losses now complained of by BUAF. No detailed traffic figures are ever published, and certainly no operating £ s d, by BUA or by the Board of Trade; and the first public signs of trouble were when Max Stuart-Shaw, shortly after his appointment as managing director, called in Mr Stephen Wheatcroft to examine BUAF. His report was not published; but no data are necessary to appreciate in broad terms the problems that BUAF have had to surmount.

First, the cost of operating Carvairs has been very much higher than anyone could have foreseen, largely because the R.2000 engine has not performed well on short-haul routes. The unscheduled removal rate and maintenance costs have been high. The Carvair would have been better with Darts (or even Centaurus?).

Then, even with the advantage of flying cars and passengers right into the heart of Europe, price competition from the trains and boats—British Rail, French Rail, etc.—has been very strong. Competition from the many excellent car-sleeper services offered by the railways has got keener every year, and so has the growth and convenience of car-hire services. But most fundamental of all are the economic effects of a four-month season and the economic nature of the aeroplane, even a specialist one like the Carvair.

Put simply, the average car weighs as much as ten passengers but may yield only about 10 per cent of the revenue while taking up twice the volumetric capacity. In other words, in terms of revenue per load ton-mile, ferrying cars just doesn't, and never has, made sense. The air ferry fare can always be a little higher than the surface ferry fare, thanks to the greater speed offered, but air ferries are hard to make stand up on their own without supplementary passengers and cargo. Even compared with cargo, car ferrying does not make sense: density of the average car in the Carvair is perhaps 3lb/cu ft—a third that of average cargo.

So why wasn't BUAF dropped years ago? Even though BUAF itself is a loser, the economics of BUA's scale are such that Air Holdings as a whole would be worse off without it. BUA have in fact cross-subsidised their car ferries with profits from other services. This is fine (except that public transport costings should be public) so long as the car ferries are making a contribution to overheads. But when they make an increasingly poorer contribution while, at the same time, profits available for cross-subsidy from other services are also less, thanks to the national economic situation, then the time comes for management to wield the axe.

Although this seems to be the end of what, when it began, we called Car Ferry Era 2, it is not the end of BUAF by any means. The cross-Channel shuttles—sea competition notwithstanding—will go shuttling on and the Carvairs displaced from the "deep" services could be available to replace Bristol Freighters which must surely be pensioned off soon. Also unaffected are the services from Southend to the nearer points on the Continent, from Southampton to the Channel Islands and to Cherbourg, and from Jersey to Dinard.

### IS LUTON LONDON?

**CRITICISMS** of the inconvenience and loss of time, particularly to interline passengers, of the use of Luton (with the North London Air Terminal) as a London base for the Tees-side service were expressed by speakers in the House of Commons on January 24. Among points made were that British Rail is, from March this year, introducing a 3hr 10min Darlington-London service; that estimates, based on a survey made last September, show that 43 per cent of the passengers from Tees-side to London were making Continental connections at London Heathrow; and this means that, on 1966 figures, about 30,000 passengers a year could be inconvenienced.

It was also pointed out that Tees-side-London passenger totals for the first 15 days of the new Luton service by Autair International had dropped (in relation to the same period in 1966 when London Heathrow was the terminal) from 1,201 to 647, and cargo traffic from 16,700kg to 4,460kg. It was considered that the ATLB, in giving the licence to Autair, should have insisted on the use of Heathrow and not Luton as the London terminal for the service. In his reply, Mr. J. P. W. Mallalieu, Minister of State, Board of Trade, said that he was unable to comment because, while there was still the possibility of appeals against the ATLB decision, the matter was *sub judice*.

**More DC-9s for Air Canada?** A repeat order for additional DC-9-30s from Air Canada is understood to be in train and one of these may be a convertible passenger-cargo version.

**Another 320C for Air-India** A letter of intent to buy a second Boeing 707-337C has been signed by Air-India. Subject to Government approval of the purchase it will be delivered in August 1968. Delivery of the airline's first -337C is expected this month.

**Airlift Reserves SST Position** Among a series of orders placed recently by Airlift International, the US supplemental, is one (in terms of a deposit on a delivery position) for a Boeing SST. The firm orders are for two DC-8-63s, the stretched fuselage, long-haul version in the 60 Series, for delivery early in 1969, and for two quick-change Boeing 727-100s for delivery in November and December this year. Airlift has also taken options on five more 727s. In addition to a \$5 million (£1.8 million) payment to Douglas, the carrier recently paid the Slick Corporation about \$8 million (£2.9 million) towards the lease and purchase of its operating assets.



## AIR TRANSPORT...

## AUTOMATIC NOISE MONITORING

ONE OF THE PAPERS read at a five-day conference on *Acoustic Noise and its Control*, held at the Institution of Electrical Engineers from January 23-27, concerned experience at Frankfurt-am-Main Airport with a system for automatic remote monitoring of aircraft noise. Such a system was considered for use at Heathrow some years ago, but was turned down for the practical reason that if the location of the remote-reading microphones was known by pilots it would be easy for them to re-route departures slightly so as to minimise the effect on microphones.

The system at Frankfurt, which has been in existence for two years, consists of a central control room, six external monitoring stations and a monitoring vehicle (similar to those in use at Heathrow) which is also used to service the equipment. Monitoring points are located at the edge of residential areas at sites selected in consultation with local authorities. Microphones are housed in weatherproof cases, which are air-conditioned and heated when necessary and are claimed to have been completely failure-proof even in severe weather. The equipment is calibrated from the control centre every hour.

The microphones are linked with the centre by Post Office lines and the output from each is recorded continuously. When the sound level exceeds a pre-set datum, the chart is printed out in red, giving an indication of the extent of the deviation

and the length of time it lasts. The total of times on which the datum is exceeded during the previous hour is also printed out. Although there is a device for injecting flight numbers, and take-off and landing times into the chart, this facility is little used at the moment. Instead, the operators correlate R/T information from the runway control with the charts.

A master record is produced of all aircraft which exceed the datum; it includes all important details, including flight numbers, weather conditions, airline and take-off direction. The characteristics of individual monitoring points have become clear over the months and the usefulness of locations has been evaluated. One factor which has emerged is that weather conditions affect the number of infringements perceptibly—they increase in bad weather and decrease in good weather.

The head of the monitoring unit at Frankfurt is a former pilot, and relations between the unit and pilots using the airport is said to be very good. The unit evaluates the recordings, maintains contact with the airlines and ATC, investigates complaints and liaises with local authorities. It also assists in drafting new flight procedures designed to reduce the effect of aircraft noise.

After two years of operation the automatic equipment has proved itself both from the point of view of integrity and basic concept. The paper did not say, however, whether it would be installed at further airfields in the Federal Republic.

## BUA-ALDERNEY DIFFERENCES RESOLVED?

BRITISH United Airways now feel that they have "virtually resolved" differences with the Channel Island of Alderney over the proposed fare increases and future services between the island and the UK mainland (see *Flight* for December 22, page 1054). BUA claim to have lost about £40,000 last year on their Alderney services. The discussions have been long, and at times heated, but Capt G. Thomas, BUA's general manager for the Channel Islands, has been very conscious that his company—as the island's only effective passenger link with the UK—has a responsibility for the economic welfare of this small community and has done his utmost to prove the airline's case to the islanders before referring the matter to the ATLB.

The outcome is that BUA have agreed to provide the additional services that the Alderney people want—giving in the region of 2,000 extra seats from England between April and October—mainly concentrated on Southampton, as the islanders requested—and in return are to apply to the ATLB for permission to introduce a new fares structure from April 1. The airline and the islanders have not quite reached agreement over the proposed new fares, but both sides are prepared to leave the final decision to the board. Alderney has, however, agreed to the principle that there should in future be no variations in fare for different days of the week and that one flat fare should be charged at all times. BUA are to ask for the following single fares: Gatwick-Alderney, £6; Southampton-Alderney, £5; and Guernsey-Alderney, £2. The present Gatwick-Alderney fares structure is: weekdays, £4 9s; Fridays and Sundays, £5 8s; and Saturdays, £6 11s. The new fares will be charged on forward bookings and refunds will be made if permission is not given to apply them.

In an age when airline operators are sometimes accused of forcing their will on small communities, BUA—who say they will still incur losses on their Alderney services—have undoubtedly shown a considerable sense of responsibility in their negotiations with this "problem" island.

**Lufthansa and the Concorde** It is believed that Lufthansa is still considering taking Concorde options. If the airline does so, the fact will certainly influence the decision of other European airlines which are not yet committed.

**Delta Re-orders** An additional order for six DC-9s, with an option on 12 more, brings the total number of Douglas short-haul twin jets on order by Delta Air Lines to no fewer than 72. Delta has also ordered another six DC-8 Super 61s bringing its total order for that type to 18. The combined re-orders are worth \$126 million (£45 million).

**Eastern Direct to Bahamas** Following the merger of Mackey Airlines and Eastern Airlines in January, Eastern has inaugurated direct flights to the Bahama Islands from points in the United States which include Detroit, Pittsburgh and Newark, NJ. On March 15, Eastern's jet services on these routes will be increased from three to five daily round-trips with further frequency increases in May.

**DC-8 Super 61 Delivered** The first 251-seat Douglas DC-8 Super 61 was delivered to United Air Lines on January 26. The type will enter service shortly on routes to Honolulu from San Francisco and Los Angeles. Transcontinental services will depend on the as yet unresolved noise question at New York. A total of 63 DC-8 Super 61s are on order by nine world airlines.

**Lake Central's 262s** Nord and Lake Central Airlines say that operational difficulties with the Nord 262 have been resolved and the airline's 12 aircraft will be returned to service as each is modified, starting later this month. The 262s were withdrawn from service following powerplant failures last August. Meanwhile several other modifications are being made, including approved air conditioning and pressurisation, and revised seat spacing, to increase passenger comfort.

**American SST Go-ahead Soon?** Speaking recently at a meeting of the National Defence Transportation Association, Brig-Gen Maxwell, head of the FAA's SST project, said that a go-ahead for the next step, stage 3, in the development of the Boeing 2707 could be expected "shortly." This includes the construction of two prototypes under new contracts to Boeing and General Electric. He said that some "economic issues" still remained to be worked out. (President Johnson, in his budget proposals announced last week [see page 180] did not request funds for prototype development. He did, however, ask for a special contingency fund of \$400 million [£143 million] in the event of an affirmative decision on the next stage of the programme.)



## JET RESTRICTIONS AND BEA

THE future growth of BEA's services is seriously endangered by the restrictions on night jet flights at London Heathrow. This is the gist of comments made by Captain J. W. G. James, the airline's flight operations director, in the latest issue of *Intercom*, BEA's flying staff journal. Night jet movements at Heathrow this summer are to be restricted (as in 1966) to 3,500, to be shared by all operators. With present plans to meet traffic increases, BEA needs more than 1,600 of them in 1967. "By 1970 we shall obviously want more than 50 per cent of the total allocation. So you will see that this method of dealing with the night jet noise problem by imposing an arbitrary limit just won't work so far as the airlines are concerned and something will have to give if we are to avoid a serious setback to our planned growth, of which night services are a very important part at present. . . . Either the Board of Trade will have to relax on the number of night jet movements permitted at Heathrow, or one or other—or both—of two alternative courses must be taken by BEA.

"We must either redesign our schedules so that only a limited number of our jet services operate out of (or into) Heathrow during the night jet restriction period, or we shall have to split operations between Heathrow and Gatwick in order to be able to operate the required number of jet services—and both of these alternatives would be extremely costly."

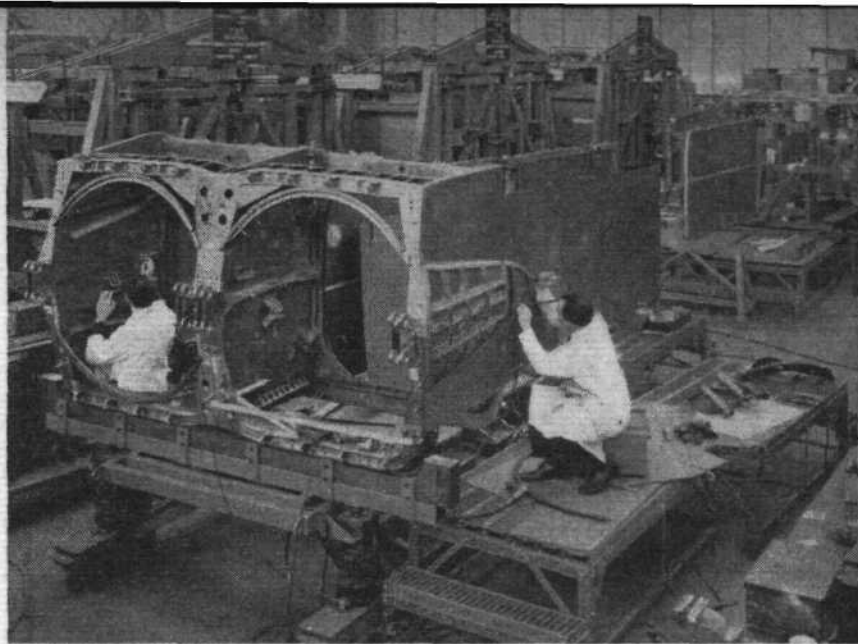
Capt James acknowledges that there is no easy solution to the problem and also that aircraft noise is a nuisance. But unless the present figure of 3,500 is increased by 1970, it virtually means that there will be a night jet ban at Heathrow and a large part of the 24 hours will be denied to BEA. It also means that the 10 to 12 million passengers BEA plans to carry in the early 1970s will have to be accommodated by squeezing all the necessary movements into fewer hours. "I believe that this problem will have to be shared between the communities surrounding an airport and the airlines using it, because airports and air services do bring great economic benefit to these communities and to the nation as a whole. There is no doubt that airlines will have to use every practicable means to minimise the amount of noise they make and the aircraft industry must exert every effort to reduce the noise made by future aircraft."

In the January issue of the *BEA Magazine*, Sir Anthony Milward, the airline's chairman, also comments on the problem. He points out that, of the 3,500 permitted jet movements this summer, 1,200 are apparently to be reserved for jet freighters. "Is this limit to be increased," he asks, "or is there to be a complete ban between certain hours? We just do not know. A mere transference of the noise to Gatwick is no solution to the problem. . . . And so we come to the question of London's third airport and there isn't any declared policy over that either. How can any airline plan for a period of ten to 15 years ahead without knowing whether it will be allowed to use the aircraft it purchases at an economic utilisation?" An airport decision, Sir Anthony says, is urgently needed if Britain is to reach and maintain a dominant position in world air travel. "We seem to be busily opting out of any chance we might have of being the great entrepôt for Europe of air travel and air freight—if aircraft can't get to London they will go elsewhere. . . ."

## PROBLEMS FOR CANADIAN PACIFIC

IF a second transcontinental service is licensed—as is expected shortly—Canadian Pacific will find it difficult to provide the necessary capacity pending the arrival of its DC-8-63s. The lease of the DC-8-51 from Trans International (see *Flight* for January 19, page 81) will not be adequate, the airline's president, Mr J. C. Gilmer, said recently, to meet CPAL's capacity needs. Because of this the airline is negotiating with a US carrier (believed to be Pacific Southwest) to obtain two Boeing 727s for the summer season. These would be used on transcontinental flights and on the airline's new San Francisco route.

Lobbying for a second transcontinental flight by Canadian Pacific is being rigorously opposed by Air Canada, but the difficulty in obtaining seats on either airline will probably mean that the application will be approved. One solution to Air Canada's opposition, favoured by many in Ottawa, is to have a capacity restriction placed on CPAL. This would nullify



The first two pairs of engine bays for Concorde prototype 001 which were recently dispatched by BAC Filton Division to Toulouse. They are constructed mainly of stainless-steel honeycomb sandwich and also contain titanium forgings and sheet components

the competitive effect of the airline's new DC-8-63s, which will almost certainly be put on this route first. The airline no longer sees itself as becoming the first Canadian carrier to fly around the world, since it feels that this would not be profitable. Thus the dream of the airline's first president, Grant McConachie, will have to wait. Mr Gilmer revealed, however, that CPAL is interested in extending its Hong Kong-Tokyo service to mainland China as soon as the Canadian Government recognises that country. He also sees no reason why the airline should not fly into the Mediterranean and Middle East areas, and believes these are the best prospects for the airline to expand in the near future. Athens, Beirut, Istanbul and Teheran were mentioned by Mr Gilmer as logical points for the service.

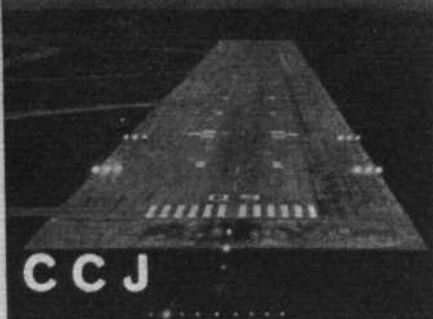
**Air Ferry Crash** A DC-4 (G-ASOG) owned by Air Ferry of Manston, and on charter to BEA and Lufthansa for the airlines' pooled cargo service, on a cargo flight from Manchester, crashed about three miles from the runway at Frankfurt at 0414hr GMT on January 21. The two pilots, the only occupants, were killed.

**Icelandic Application Rejected** The Scandinavian governments have refused the application by Icelandic Airlines (Loftleidir) to introduce CL-44s on services between the three countries and Iceland. The airline will, therefore, continue to use DC-6Bs on these sectors. A request for reduced Scandinavian-New York fares has also been rejected; these will remain at the present levels—or 13-15 per cent lower than IATA rates.

**Redifon in Iran** The Iran Civil Aviation Authority has formally accepted the new communications system for Esfahan International Airport, thus marking the completion by Redifon of a £500,000 contract for the complete re-equipping of four of Iran's major airports. New communications systems for Shiraz, Abadan and Mehrabad airports have already been installed and are now in operation.

**Airport Figures for 1966** Provisional figures from London Heathrow for 1966 show that there were 223,808 aircraft (8.5 per cent up on 1965) and 11,938,817 passenger movements (12.4 per cent up). Birmingham's passengers totalled 534,558 (13.8 per cent up) and 4,585 short tons of cargo were handled (52.6 per cent up). Leeds/Bradford topped the 300,000 passenger mark for the first time with a total of 300,561 (10.5 per cent up); and cargo totalled 1,888 short tons (44 per cent up). Among other airports, Staverton (Gloucester/Cheltenham) recorded big increases of traffic, with 32,003 aircraft movements (71 per cent up on 1965) and 31,387 passengers handled (68 per cent up).





## Vertical Separation—3

**T**HIS VERTICAL SEPARATION series\* is intended to examine the height-keeping errors deriving from (1) the altimeter, (2) the static source and (3) the pilot or the autopilot. This examination, which is parallel to other studies at present being undertaken in many parts of the world, may or may not lead to a definite assessment of a satisfactory vertical-separation interval; it is, however, bound to lead to a better understanding of the problems involved. For example, it is planned later in the year to include the results of the IFALPA worldwide survey of the altimeter and flight technical errors; this began on January 1, 1967, and is yielding a large flow of new data on these two components of the total height-keeping error. Meantime it would seem opportune to take a first detailed look at the remaining component, static system calibration error, since this has been the subject of an authoritative statement by the ICAO Airworthiness Committee Meeting in November 1966, but has not, so far as I am aware, been publicly reported upon.

This meeting analysed four methods of static system calibration and gave the results as follows:—

Height (feet) 1	Method	Calibration accuracy ( $\pm$ feet)		
	Pacer aircraft 2	Radar tracking 3	Trailing cone 4	Tower fly-past mean value 5
5,000	5	—	8	—
10,000	25	16	26	13
30,000	28	24	29	18
40,000	31	30	32	28
50,000	40	28	42	45

Of the four methods given above, three were briefly described in the previous article on this subject. For present purposes it is not necessary to go further into any method except (4) since this, the trailing-cone method, has been accepted by the ICAO Airworthiness Committee as being the simplest and cheapest to apply and, in view of this, it has been recommended as a future Provisional Acceptable Means of Compliance (PAMC) for association with the international airworthiness requirements of ICAO Annex 8. If, therefore, all the provisions of the PAMC are universally applied, we should fetch up with a static calibration system yielding errors no greater than those shown in column 4.

I say "universally applied" because there are plenty of reasons why accuracies of this order are not universally applicable at the moment and may not be for quite a long time.

**More Eagle Jet Services** From April 1 all of British Eagle's international services from London, except those to Innsbruck, will be operated with BAC One-Elevens. Jets will also be introduced on international services from other British centres, including the new Liverpool/Manchester-Frankfurt service being started on June 12, and on the services from various UK points to Newquay, Cornwall.

**Noise in the House** In written answers to various questions in the House of Commons last week, Mr J. P. W. Mallalieu, Minister of State, Board of Trade, said that he did not propose to restrict night jet movements at London Gatwick this year, because the airport was still under-utilised, but would be examining the position in "a few months' time" in relation to future years. A permanent noise-monitoring unit would, he hoped, be set up before the peak summer traffic period this year. He also said that he would make a further statement soon about noise certification of civil transport aircraft.

In the first place it has to be demonstrated that *all* States have the facilities for attaining the very high accuracies obtained under the test conditions on which the above table is based. Other important questions which arise are, assuming that the draft PAMC gets through ICAO (which it probably will during 1967), who has the authority to make this very demanding test procedure apply to the military? At the third meeting of the ICAO Vertical Separation Panel in 1958 the military representatives stated that they could not undertake to fit *any* static correction device, either of the Kifis or of the "manual" card-correction variety. Similarly, who can make it apply to the airlines of the non-ICAO States (including Russia), who share the airspace with us? Who can oblige the rapidly growing band of general aviation jet owners to calibrate their static systems and to do so at prescribed intervals? What happens when the aircraft is subject to a non-standard boundary flow, as when flying one-engine out, or when carrying an extra podded engine?

These are not in any sense hypothetical questions. For example, with regard to external carriage of the spare engine, only for the VC10 is this data published—it amounts to some 600ft of altitude! Nor is that very exceptional. Even without any such obvious influence on boundary flow, the variation of one aircraft from another of *exactly the same type* may amount to a figure of this order. In fact, the most recent study of the subject which I have been able to trace, namely NASA report RD-64-157, says this:—

"Limited flight tests were conducted using the trailing-cone static pressure-measuring technique to determine the repeatability of commercial jet aircraft altimeter systems. The maximum difference between the six types tested at 30,000ft was 500ft."

With this kind of result perhaps it is small wonder that the participating airlines retired early from the experiment and the report concludes:—

"It is noted that only 15 of the desired 39 aircraft were tested due to the non-availability of the commercial jet aircraft. Due to the limited nature of the data, therefore, no technical conclusion can be drawn and, accordingly, no recommendations based on present data can be made."

Luckily I am not so inhibited about recommendations as is NASA. I recommend that the figures given in the table above under column 4 should be demonstrated as obtainable by the average airline, under the testing facilities reasonably available, before they are used as a basis for calculating the safe vertical-separation interval.

\*Part 1 appeared in *Flight* of August 18, 1966; Part 2 in the issue of October 13, 1966.

**New York - Moscow** The inter-airline agreement between Pan American and Aeroflot was signed on January 23—bringing up to date the one initialled five years ago. Each airline will operate non-stop return services twice weekly from May to September, and once weekly from October to April. PAA will use Boeing 707s and Aeroflot will use Tu-114s until the Il-62 goes into service. Flights will start in May.

**Braniff Takes over Panagra** Final payments by Braniff Airways to W. R. Grace and Pan American for their 50 per cent shares in Panagra have now been made and combined services were started on February 1. The total purchase cost was \$30 million (£11 million). Braniff is taking over Panagra's four DC-8s as well as the airline's order for five DC-8-62s due to be delivered from May this year. Braniff also has four Boeing 707-320Cs and 12 Boeing 727s on order for delivery this year.



## PAA's "CO-TERMINAL" RIGHTS

THE long-sought-for US co-terminal rights have now been obtained by Pan American which will, soon after the effective date, March 12, inaugurate a daily San Francisco - New York - Paris - Rome service. The co-terminal points now available to PAA are Los Angeles, San Francisco, Portland, Seattle, Chicago, New York, Boston, Philadelphia, Washington/Baltimore and Detroit. The new rights permit the airline to carry passengers from the US West Coast eastward to Europe and elsewhere, and passengers from other countries across the US in either direction—with stop-over privileges for all passengers in New York. They do not permit PAA to carry purely domestic passengers, or to carry westbound travellers from New York.

## STABILITY FOR CALEDONIAN

INCREASED share capital, in preparation for the introduction of two Boeing 707-320Cs into its fleet, has been provided by two new shareholders in Caledonian Airways. They are Industrial and Commercial Finance Corporation and National Commercial and Schroders (Development) of Edinburgh. Airways Interests (Thomson), in which many Caledonian staff are shareholders, remains in control of the company which now has capital and reserves of more than £850,000. Results for the year ending September 30, 1966, showed a profit increase of 136 per cent over the previous year—from £86,883 to £205,085. Revenue increased by more than £1 million to £4,605,512, and, as total passengers carried rose only by 11.4 per cent, much of this increase must have been attributable to the revenue from freight carried on the Zambian oil-lift operation—10,366,191lb in all. North Atlantic traffic also rose spectacularly from 22,750 to 36,786 passengers, an increase of 61.7 per cent.

Announcing the new capital structure and the results for 1965-66, the airline's chairman, Mr Adam Thomson, made some forthright observations on the independent scene in the staff newspaper *Caledonian International*. Among the difficulties which he said were facing British independents, opposition from foreign carriers came foremost. Mr Thomson went on: "... in spite of the opposition from the British corporations to any proposed development of Britain's independent airlines, I believe, with a few exceptions, the competition offered by the independents to the corporations is almost negligible." After reminding his staff that foreign independents often had a clear-cut positive government policy to encourage their development, Mr Thomson continued: "British independent airlines suffer from the whims and fancies of each succeeding Minister who is hardly in his seat long enough to appreciate the overall problems before he is moved on. I do not believe it is the case, but it could certainly appear to be the present Government's policy, to actively oppose the development of independent airlines." He quoted the examples of loss of investment allowance on new aircraft and the "obvious discrimination by charging duty against the particular independent airlines which

have to purchase competitive American aircraft to effectively continue in their existing markets. . . .

"The transferring of military troop flights to the Royal Air Force Transport Command will undoubtedly cost the British taxpayer a great deal of money," said Mr Thomson. "To date the bidding on military contracts has been extremely competitive. The effect of the new policy will be to reduce the number of aircraft available to the Ministry of Defence for overseas emergencies and to cost the Government more money at a time when the stated aim of the Treasury is to reduce Government expenditure.

"It is time for the Government to recognise the increasingly important part British independent carriers are playing in world aviation markets; it is time for the Government to study with imagination the probable development of international air transport over the next few decades; it is time for the Government to plan with the British operators a policy which will ensure that the British airlines can effectively compete with foreign carriers in present and future world markets."

## CAT 2 FOR DC-8-61

THE Federal Aviation Agency has given approval to the Douglas DC-8-61 to make auto-coupled and manual approaches (in the latter case using the flight-director) in Category 2 weather conditions. When fitted with a Sperry SP-30AL autopilot, a Collins radio altimeter and a flight director developed jointly by Douglas and Sperry, approaches may be made to decision heights of 100ft in horizontal visibilities down to 400 metres.

During certification flights several one-outboard-engine-out approaches were made successfully. The FAA approval covers a number of control combinations on normal approaches, both with and without auto-throttles and yaw dampers. An automatic overshoot system, specifically designed for the DC-8-61, was also certificated. A similar programme to Cat 2 standards is now being carried out on the DC-8-62.

**Air France's New Chairman and President** M Georges Galichon has been designated as chairman of the board, and president of Air France in succession to M Joseph Roos, whose term as chairman expired last week.

**FAA Appointments** Mr Chester G. Bowers has been named as director of the FAA's airports service and Mr William M. Flener as deputy director. Both are rated pilots and have been with the FAA and CAA for more than 20 years.

**Swissair at Heathrow** Mr Peter W. von Felbert has been Swissair's station manager at London Heathrow since February 1. He succeeded Mr W. J. Kuemin, who has returned to Zürich as station inspector. Mr von Felbert has been with Swissair for over ten years.

British Midland Airways have taken delivery of their first Viscount (a 736), seen here on the day of its arrival at East Midlands Airport, and will receive the second and third (both 831s) this month and early in April respectively

"Derbyshire Advertiser"







The USAF Systems Command team in London: (left to right) Maj-Gen G. F. Keeling, Col Elmer Smith and Lt-Col J. Barton

## MANUAL GUIDANCE

### —on Selling to the USAF

**F**IRST of all, the intention of these sessions is to give you a broad idea of the environment and climate of procurement of the US Services. Also to expose you, if you like, to what the American main contractors have to put up with so that when they come to you on subcontract business you have an idea of what it's all about . . .

The speaker was Mr John R. Christie, Under-Secretary (Exports), Ministry of Aviation, first-day chairman at a three-day defence seminar organised in London last week to explain to British industry how to sell defence equipment to the United States. Mr Christie's audience on January 25 were described as top management; their articulate guides through the paper maze of USAF and DoD directives, regulations, manuals, logistics concepts, system definition activities, configuration management systems and the rest were Maj-Gen G. F. Keeling, Head of Procurement and Production, USAF Systems Command, and Col Elmer Smith, also of Systems Command.

Third member of the team was Lt-Col J. Barton, who joined with Gen Keeling and Col Smith to give a more detailed dissection of the subject to a "middle management" audience of project managers and engineers on January 26 and 27. The three-day meeting was organised by three trade associations—the Society of British Aerospace Companies, Electronic Engineering Association and the Society of Aircraft Manufacturers—with the support of the Ministry of Aviation.

Gen Keeling outlined the structure of Systems Command, responsible for spending almost \$7,000 million or 31 per cent of the USAF budget, administering over 5,500 contracts and with an "undelivered balance" of \$4,500 million. Its mission, the colour slide proclaimed, was to *advance* aerospace technology, *adapt* technology into weapon systems, and *acquire* weapon systems and material. Separate divisions within the command dealt respectively with electronics systems, aeronautical systems, ballistic systems and space systems.

After Gen Keeling came Col Smith, a blue-suit Billy Graham preaching the gospel of systems management with a practised fervour and a box-full of colour slides. Air Force Regulation 375 was the Good Book. "It names everyone that's gonna be in this ball-game. We establish the ground-rules for the ball-game. We tell who the players are and how they're gonna relate with each other . . . It says you have one office in the Air Force that's responsible for the programme . . . It says you're gonna have one man to run this show. He's the programme director. He's the man who gets fired when it goes bad . . . It says you're gonna document what you do and that's our package plan and it throws a lot of people but it's a good document because you've got everything that pertains to that programme written down in summarised language in one document . . ."

Under the system programme director, the colonel explained, there were five groups concerned respectively with configuration management ("They're good guys but you've gotta watch 'em"), engineering, management, procurement and production, programme control, and test and deployment.

One of the purposes of the procurement and production people was to monitor government-furnished equipment so that it was in phase with production. On one aircraft "the research programme kinda slipped about 18 months on us . . . but the government-furnished equipment was never slowed down to the production schedule and we found ourselves making the first flight, and you've got 300 central air-data computers sitting there in the contractor's warehouse that have never been flight-tested, so you make your flight test and the doggone thing doesn't work, so you've got 300 of these to retro-fit and rebuild so they *do* work . . ."

All aspects of deployment had to be considered. One type

of aircraft with elaborate electronics had been deployed in Europe but "we got 'em over there and we couldn't check 'em out, it was that simple, nobody had gone over to check the doggone electrical systems over there that were available to us. We found out that power over there fluctuated too much to the extent that we could not use the sophisticated checkout equipment that we had. So we had to go in and put a lot of generators in, and modify some distribution systems over there, so we could make the airplanes operational . . ."

After a break for coffee, Col Smith resumed his rapid-fire sermon, taking as his text "Blessed are those who study configuration management, for they shall get contracts" (or words to that effect). And what was configuration management? It was "a discipline applying technical and administrative direction and surveillance to properly identify, control the changes to and record the status of the configuration of an USAF system/equipment or components thereof."

The relevant manual was AFSCM 375-1—not so much a manual, actually, more a documented court-case, with no fewer than 19 exhibits attached. This, Col Smith admitted sadly, had caused the most trouble here in the United Kingdom:—

"You saw that and you said immediately 'Ye Gods, anything that thick can't be good for me,' and as a result you reacted violently to it and we have had many contractors going to our Department of Defence and into the Washington area and telling everyone who would listen to them: 'If you had left that off the damn contract or out of the request for proposals I could bid a third less.' That's a lot of baloney and I'll explain it to you as I go through this thing."

Col Smith explained it to us as he went through this thing. "You may have black boxes in there that are common to more than one airplane—you may have in, say, an F-4 an inertial system that's identical to one in the C-130, for example. Now in the 130 you've got all the room in the world when that thing is installed, so you have no problems. So the manufacturer of that inertial system gets into your higher government echelons and says 'Gee, if we added these modules to it, Boy, this thing would be the greatest thing on Earth,' so you say, 'Real great' . . . But here you're using it in this airplane between two bulkheads, you can't take all these goodies, so you have to control this interface, now, of equipment put in the airplane itself and the supporting equipment, and how do we do this? Well, we do it through a series of specifications, and this is the thing that starts to throw you people in industry."

"Now from here on these things become part of contracts we reference in the contract by exhibit numbers. . . . Now let me assure you this is nothing new, you've been doing it for years, the only thing is you call it by different names. . . ."

Reassuring the doubtful, encouraging the faithful, Col Smith led us confidently on through the valley of the shadow of end-item specs, prime equipment, facility items, non-complex items, inventory items, engineering and logistic critical component specs, spec maintenance, standard numbers, acceptance criteria, preliminary design reviews, critical design reviews, first-article configuration inspections, formal qualification reviews, changes to system specs, changes to end-item specs, engineering release record requirements, verification of production incorporation of Class 1 changes, data elements and reports, manually prepared reports, machine-prepared reports, system life cycles, the conceptual phase, the definition phase, design and development activity, production activity, and much more besides. Air Force 375, there seemed little doubt, would solve all our problems and lead us to the promised land of offset sales.

K.O.



# MUCH ADO ABOUT SOMETHING

A Play of One Act Concerning the Aerial Merchants of Britain and their Charters

by ROGER BACON



## Dramatis Personæ:

ALFRED BARNABY-CHANCE, Keeper of the Licences of BF Airways (British Frustrated Airways).

XERXES Y. ZALDOR, Assistant to the Governor, AF Air Lines (American Freedom Air Lines).

Mine host, serving wenches, aerial pirates, revellers, etc, etc.

## The Scene:

A hostelry near Heathwick Aerial Station.

ENTER Mine host, to place a flagon of ale on the table before Barnaby-Chance, who gives in exchange a coin of the realm. A serving wench pauses at the table but, perceiving the black looks on the face of Barnaby-Chance, flounces off to join a band of aerial pirates newly arrived with a prize cargo from far Cathay.

Barnaby-Chance sips his ale, then glances at his timepiece: 'tis eight of the clock. At that moment a close cropped fellow of lusty mien strides to the table with hand extended.

ALFRED BARNABY-CHANCE. Well met, O friend from overseas, come order,

What's your pleasure, Master Zaldor?

XERXES Y. ZALDOR. Why, thank you, friend, and mine shall be A dram of spirit from Auld Reekie.

A.B.C. Well said, lootenant; and upon mine host a pox If he doth not supply it on the rocks.

X.Y.Z. How well you mind my foreign taste, For as the dog doth seek a cooling spot to lie, I too do yearn for cooling draughts To quench my thirst and help my temper die.

A.B.C. Come now and why should you be tense, Your permits granted for your ocean flights? And well I know that even now this year, Your hulls will ply with bulging cargoes.

[he pauses.

Ah! here's mine host and may we raise our glasses. And talk before yon maid doth try some passes.

[Both touch glasses and drink.

X.Y.Z. My temper now is dying fast, due drink and company, 'Twas but a passing thing—anxiety for our agreement.

So now, how doth our handling deal proceed And will our cargoes be discharged with all dispatch?

A.B.C. We have our fingers out and verily I say to you, That as the miser doth with trembling fingers, Grasp the coins and hasten with them to his coffer, So we, but with all good faith and honest toil, Ensure that your own prizes will with every speed, Be checked and speeded on their way.

X.Y.Z. Well said, and on the morrow when the clock strikes nine,

Will I and all my minions visit you And thereupon inspect your tackle and your men And if all be well, will to the document prepared Affix our seal and signature.

A.B.C. Your custom is of great import to my concern Yet I must with some reluctance ask

That you and yours delay our joyful meet And make it three o'clock, because a task, Late thrust on me, compels my presence 'fore a Minister To plead with righteous ire against A licence refusal.

X.Y.Z. But stay, why should you have to argue thus?

When last we met you were so gay and spry Because you felt that you could make a case For ocean-spanning cargoes through the sky. And this was placed before a Board of men Who, having been appointed to the task, and Being of much experience in such things Could weigh and ponder on your application And reach decision in concert with their charge To further British aviation. Who is he who doth present you With this bag of snakes?

A.B.C. You are correct that eight experienced men

Full of years and wisdom and of great repute, Were well equipped to listen to our plea For cargoes winging to the eastern sea. But now comes Jay, who in first flush of power, Doth take misguided guidance of himself, And no doubt the faceless servants in the Ministry, And without thought gives argument to those Who, being foreign powers, do look for protection 'gainst our enterprise;

Takes advantage of a section of the Act and by order Prevents the Board of worthy men hear our case.

X.Y.Z. But Al! 'Tis as arbitrary and harsh As a sultan, who, fearful of foreign devils, Doth prevent his merchants freely ply their trade, Or sail anywhere at which his own State company Or its favoured friends, fear that free enterprise May upset their pooled monopolies.

A.B.C. How right you are! And even though your own authority

Doth itself conduct in interest of the common weal, You con the fact that doctrinaire politicians Do play shuttlecock with our inheritance, Making nonsense of our standing in the world And of the efforts of the Board of Licensing.

X.Y.Z. 'Tis an attitude which, allowed to flourish, Will give delight to those whose shackled trade, Shrinks from the play of free ideas and enterprise Reducing all to pools and quotas and the like, Stifling initiative, forgetting that this very effort

Footnote Uncle Roger would like to acknowledge inspiration from MANADAV—Management Advisory Services (Aviation) Ltd

Concluded overleaf



## MUCH ADO ABOUT SOMETHING . . .

Springs from the glorious past when merchants  
Anxious as the trembling maid in wedding bed,  
Did notwithstanding grasp the nettle, talk and argue  
And make arrangements, which though profitable to them,  
Did in fullness of time benefit the Common Wealth  
And those who in the early stage did protest loudest.

A.B.C. But more than that, it doth with one fell swoop  
Make impotent the power of the Board, who,  
Charged with the task of hearing applications  
Directed to them by anyone so qualified,  
May now judge only matters which the Minister  
In his Socialist blinkers, judges fit to be judged  
And leaves them with a famished minor list  
Of things of lesser pith and moment till,  
Angered by such dictatorial snubs,  
They rise in anger and suggest to him who orders  
That he visit a taxidermist.

X.Y.Z. It does appear that you and your companions  
Frustrated in your efforts, angered by the Socialists,  
Yearn for the freedom of the Tory party,  
Who, whilst far from perfect, at least laid down  
A liberal way of aerial trading for the common good  
And gave you and friends the chance at least  
To ask and argue, fight and trade and gain.

A.B.C. Now hold, you are but partly right,  
For though the Tories, in concert with their conscience  
Did lessen the shackles of the merchants of the air,  
They did, in ignorance or maybe fear of giving to the Board  
Too much power, leave it emasculated.  
No tariffs of air cargoes going foreign,  
No fares for pax to visit far-off climes  
Can be discussed before the Board,  
But remain the province of successive Ministers who,  
Bound by party interests, wedded slavishly to IATA,  
Rubber-stamp such international decisions and are content  
To leave such vital matters as prices in limbo.  
And yet the Board, expected to give worthy judgement  
Cannot consider tariffs. 'Tis a nonsense.

X.Y.Z. Our country boasts a CAB which far from acquiescing  
Actually challenges such international concepts  
And by such pressure doth lower fares and benefit all.  
'Tis a pity that your Board is not so powered.

A.B.C. It is indeed, and yet the story doth not finish there.  
Our Board, called upon to judge on foreign trade,  
Cannot, in addition to its impotence with tariffs,  
Take into thought the various trading permits  
Which an applicant for foreign service will require  
And which sardonically are called "traffic rights."  
"Rights"! Why, man, we have no rights but those  
That given by us in reciprocity, are given to us  
And without which we have no rights at all.  
The theory may be that restricting our requirements  
Before they have been put to foreign powers,  
To one company, and that usually State,

Our requirements for the State concern are not in jeopardy.  
And yet, in circumstances wherein it doth suit him,  
The Minister makes nonsense of his own advice  
And designates not one but two traders, and that  
From Beatleland to Cork, in Southern Eire.

X.Y.Z. 'Twould make me laugh if 'twere not so sad  
That men with minds so subject to change,  
Should be in power o'er such vital trade.  
Or, like a father wishing to fix two daughters in wedlock,  
Lets it be known before negotiating,  
That the bigger of the two carries a larger dowry,  
Is then shocked when prospective father-in-law,  
Discounts the smaller e'en for a second son,  
Leaving the father without negotiating power,  
And the smaller maid's potential unfulfilled.

A.B.C. Yea, 'tis a procedure to shame a barrow boy.  
And yet again to make more nonsense of the thing  
The very man to whom the Board is answerable,  
Bearing in mind that the Board hears arguments  
'Twixt State and independent merchant traders,  
Is himself charged by virtue of his office  
With the wellbeing of the State concerns,  
So that when a trader, hand in hand with prudence,  
Applies for voyages in opposition to the State trader,  
Despite the wisdom of such venture and its backing,  
The Board if so directed, drops the case.  
And even if, through doubt the hearing is allowed  
And the Board grants the permit, then all can go for naught,  
When a State concern concerned with competition makes  
appeal,  
The Minister can over-rule the Board and thus revoke it.

X.Y.Z. From what you say it would appear  
That the Party of free enterprise,  
Did by virtue of their Act leave power in political hands,  
And, though giving the Board teeth, made them false,  
To be drawn at the whim of transitory doctrines.

A.B.C. The answer lies not in the Minister, but in ourselves  
That we are under-vocalised.  
That being so engrossed in matters of financial moment,  
We give no time to formulation of a policy  
Which, whilst ensuring no curtailment of the State concerns  
Would give full power to the Board to judge  
And that if either State or independent doth object  
To such decisions as the Board may take,  
Then only when the moon has filled itself six times  
Can they make re-apply for re-consideration.  
And that failing satisfaction from such act  
Their one recourse is to a court of law.

X.Y.Z. Methinks your cause the better served would be  
If feeling as you do you take the time,  
To make your voices heard in strong campaign  
To stir your colleagues from their daily round  
And make some common protest to their gain  
And those that come after them.

A.B.C. Amen to that, and thanks for lending me an ear,  
You make me feel that all's not lost:  
On that we'll drink a beer.

*[they raise their flagons. Exeunt all.]*

## DIARY

Feb 2 RAeS Halton Branch: Space Symposium—Lt Cerchione and USAF team.

Feb 2 RAeS Southend Branch: "Are Aircraft Electrics too Complicated?" by H. Zeffert; Queen's Hotel, Westcliff, 7.45 p.m.

Feb 6 Air League: Mansion House Luncheon—Speech by Mr G. W. Reynolds MP, Minister of Defence (Administration); 12.30 p.m. for 1 p.m.

Feb 6 RAeS Cranwell Branch: "Development and Flight Testing of the Hawker Siddeley Kestrel," by A. W. Bedford; Whittle Hall, Cranwell, 8 p.m.

Feb 6 Kronfeld Club: Instructional lecture on finer points of flying, by Flt Lt Derek Piggott; 74 Eccleston Square, London W1, 8 p.m.

Feb 7 RAeS Bedford Branch (joint meeting with IMechE): "Research and Proving-ground Trials at the Motor Industries' Research Association," by Prof R. H. MacMillan; Mander College, Bedford, 7.30 p.m.

Feb 8 Kronfeld Club: "Readers and Writers," by Michael Bird; 74 Eccleston Square, London SW1, 8 p.m.

Feb 8 RAeS Test Pilots' Group: "Some Thoughts on Flight Instrument Presentations," by Sqn Ldr T. E. Gill; Apprentice Training School, BAC (Operating) Ltd, Weybridge, 6 p.m.

Feb 8 RAeS Chester Branch: "Ways of Water—Some Aspects of Scaled Models Applied to Waves and Harbour Designs," by B. V. Derbyshire; Lecture Theatre, Grosvenor Museum, Chester, 7.30 p.m.

Feb 8 RAeS Hatfield Branch: "Replica Vintage Aeroplanes and Film Making," by Air Cdre A. H. Wheeler; HSA Senior Staff Restaurant, 5.30 p.m.

Feb 8 Society of Instrument Technology: "Automatic Testing Applied to Aircraft Electronic Systems," by A. H. Parker, and "Techniques of Satellite Launcher Checkout," by P. J. Waples; Mansion House, 26 Portland Place, London W1, 5.30 p.m. for 6 p.m.

Feb 9 RAeS: "Reinforced Plastics in Lift-jet Engines," by H. E. Gresham and W. Hannah; 4 Hamilton Place, London W1, 6 p.m.



# ENGINE NOISE

## Past research and some new remedies

Among the contributions to the recent international conference on aircraft noise convened in London by the Board of Trade ("Flight," December 8, page 975) was a paper by two Rolls-Royce engineers, Mr F. B. Greatrex, MA, FRAeS, AMIEE (chief engineer, staff engineering) and Mr R. Bridge, BSc(Eng), AFRAeS (development engineer, noise). In it they showed how engine noise characteristics had changed with the trend towards the use of higher by-pass ratios, and went on to demonstrate why the new generation of high-by-pass engines is claimed to offer unprecedented built-in noise-attenuation features for a remarkably small operating penalty. The paper—bearing the title "The Evolution of the Engine Noise Problem" and read by Mr Bridge—is reproduced here almost in full, together with some of the illustrations.

**A**N ENGINE HAS two basic significant sources of noise (Fig 1): the propulsive jet with its turbulent mixing process; and the interaction of blade wakes and stators. There are two significant sources of blading noise: the turbine, the noise of which radiates aft with the jet noise; and the compressor, or fan, the noise of which divides between the upstream and downstream directions. The upstream propagation emerges from the intake and radiates mainly in a forward arc. The downstream portion propagates along the by-pass duct or fan duct and emerges from the final nozzle or fan nozzle, depending on the ducting arrangement.

For a typical low-by-pass turbofan, three significant noise radiations in the rear arc are jet noise, with a peak at the characteristic angle of 30°-40° to the jet axis; and turbine noise with rearwards compressor noise, radiating mainly at 60°-70° to the jet axis. With the low-by-pass engine the rearwards compressor noise radiation is small compared to the turbine noise. The compressor noise emerging from the air intake radiates in the forward arc with a peak at 50°-60° to the intake axis.

The main radiations are identified by taking measurements along a line parallel to the engine centre line. At low powers two peaks are found. These correspond to the turbine and forward compressor noise lobes. They are identified by narrow band analysis and comparison of the discrete tone frequencies with numbers of blades on the compressor and turbine stages. It was reported in 1960 by Mr Greatrex that this double-peak feature at low power was observed in a fly-past noise exercise. At the time, the narrow band analyses, which were complicated by Doppler effects, were misinterpreted so that the rear peak was erroneously identified as being due to the second harmonic of the compressor first-stage blade passing tone. Re-examination of this surprising result led to the more logical identification of the discrete tone as the fundamental of the turbine final

stage which had very nearly twice the number of blades as the compressor first stage. From that point on, turbine noise was readily identified on all types of engines, especially on static rig tests with no Doppler complications.

As engine power is increased the compressor and turbine noise levels rise in accordance with a law whose basis is indicated in Fig 1. Jet noise, which is insignificant at very low power, increases more rapidly with the other law with a higher velocity index. Thus, eventually, jet noise becomes the governing feature at powers near maximum. The overall peak of the noise field always occurs in the rear arc. The forward compressor noise is greatly exceeded by jet noise at high powers and slightly exceeded by turbine noise at low powers.

The left-hand chart of Fig 2 depicts the variation on peak fly-past noise with thrust from the pure jet engines of the 1950s. The turbine blading noise is not significant except at low thrust such as might be used for landing (35-50 per cent thrust). The noise level inflicted on the airport community was high relative to the standard set by the obsolescent piston engined aircraft. A considerable effort to investigate jet noise and its attenuation achieved the required degree of silencing with tolerable penalties on performance and operating costs.

The other charts of Fig 2 are similar plots for various by-pass engines all scaled to the same thrust. The comparisons are of the significant noises radiated directly into the rear arc where the overall peak occurs; the weak compressor noise radiation from the intake is omitted, being comparatively irrelevant.

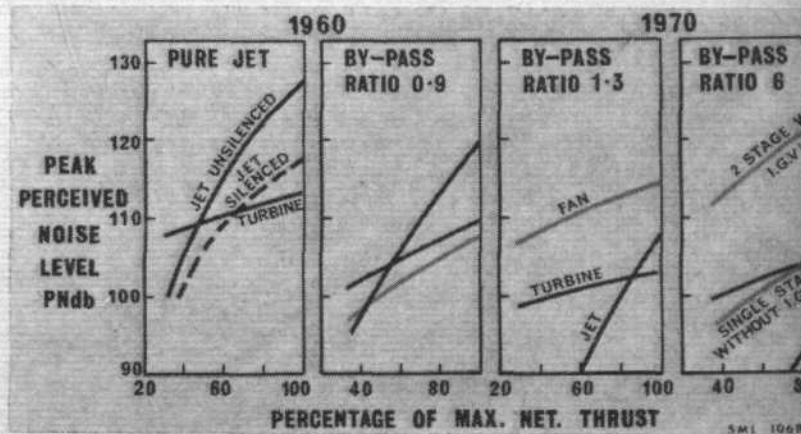
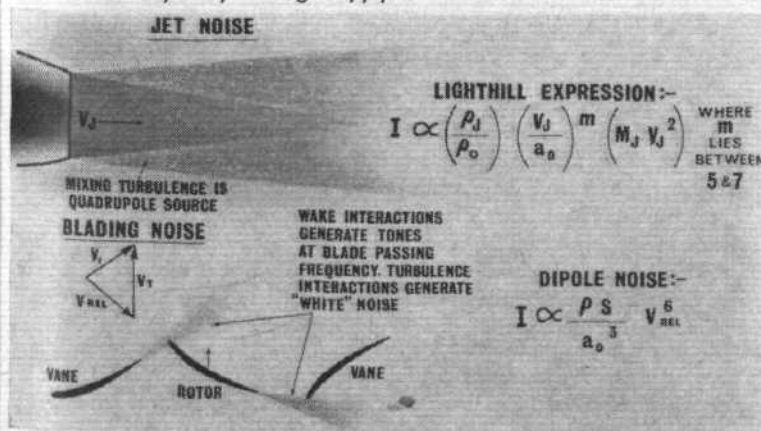
Compared to the pure jet engine, the by-pass engine obtained a given thrust from a higher mass flow with a lower jet velocity and hence, increased efficiency. The lower jet velocity with a by-pass of 1.0 means that the jet noise level is reduced to a degree comparable with that achievable by an effective jet silencer but without the performance penalties of the latter.

Because of the available path rearwards along the by-pass duct, the compressor noise that does appear in the rear arc is overshadowed by the turbine noise. All in all, the noise situation with a by-pass of 0.9 is an appreciable improvement over the pure jet.

Increasing the by-pass to 1.3 reduces jet velocity, and hence jet noise, still further. However, a most significant feature of increasing by-pass now emerges. The downward trend of jet noise is countered by an upward trend of fan noise. This is because the increase in mass flow with increasing by-pass is most effectively achieved by raising the fan blade velocity whilst keeping turbine blade velocity substantially constant.

Now this particular change of by-pass from 0.9 to 1.3 is not a good one from a noise point of view. There is certainly an improvement at maximum take-off thrust, due to the fading jet noise being only partially replaced by fan noise. However, at thrusts lower than about 75 per cent the fan noise of the 1.3 by-pass engine is appreciably greater than the jet or turbine noise of the 0.9 by-pass engine. Thrusts for noise

Fig 1 (left) The main sources of noise generation in turbojet and turbofan engines are the exhaust and turbine blade/stator aerodynamic interaction. The formulae show the significance of velocity on aerodynamic noise. Fig 2 (right) Components of peak engine noise in the rear arc as they vary during a fly-past at various thrust levels. All engines scaled to the same thrust and at 1,050ft and 185kt





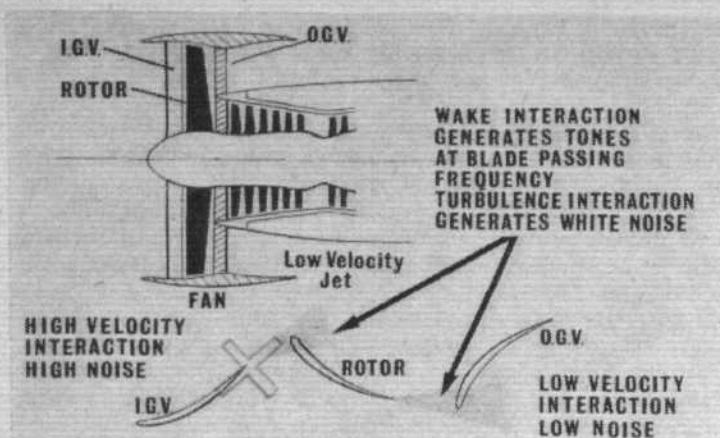


Fig 3 Elimination of the inlet guide vanes halves the principal sources of noise in the new generation of single-fan high-bypass engines

## ENGINE NOISE...

abatement cut-back and for landing approach fall below 75 per cent so that, clearly, the 0.9 by-pass engine is effectively the quieter.

By increasing the by-pass ratio still further the divergence of fan and jet noise continues. At a by-pass of 6.0, jet noise becomes completely insignificant but, due to excessive fan noise, the overall effect is a deterioration. In fact, the situation appears worse than with the original pure jet.

Before discussing the solutions to the high-bypass noise problem there are a number of points arising from the noise ramifications of advanced engine technology. First, as mentioned earlier, only the rearward arc radiations are plotted in Fig 2. Forward arc fan noise is comparatively insignificant.

Noise generated by the blading of a compressor or fan propagates both forward and rearwards. The medium of propagation is, of course, the air flowing through the system. If the velocity of the airflow were equal to that of the speed of sound in air then, clearly no noise energy could propagate upstream. It follows that all the blading noise generated would be forced by convection to flow rearwards. The phenomenon is not a sudden cut-off at Mach 1 airflow. The convection effect is present at any velocity, but rapidly becomes more marked as Mach 1 is approached. The rearward convected portion of the forward noise adds to that which would propagate rearwards at any velocity. The maximum augmentation of the rearwards noise is 3db, which occurs at airflows of Mach 1 and above. The axial velocity through a compressor or fan is always appreciably below Mach 1. However, the velocity in the passages between adjacent blades is greater than the axial velocity and can exceed Mach 1. The convection effect takes place in these passages but because the passage velocity at the blade root is considerably less than at the tip, there is no complete cut-off as in the case of a uniform passage flow of Mach 1.

It may be concluded that, with modern fan blade velocities around Mach 1 even at low power, fan noise emerging forwards from the air intake is a relatively unimportant component of the total radiation field.

**Fan Noise Character** The spectrum of blading noise comprises a background of "white noise" distributed over the whole audio range with tones protruding at discrete frequencies. White noise is generated by the interaction of blading with turbulence. The discrete tones are generated by the siren-like action of rotor blades passing stator blades, and their location in the spectrum corresponds to the frequency of passage of the blades. In comparison with the multi-stage compressor, the discrete tones of the single-stage fan protrude further from the white noise background. This is mainly because the white-noise background of the multi-stage compressor is built up relative to the blade-passing tones by the adding together of the white-noise output of several stages.

The subjective effect of noise is appreciably influenced by the presence of discrete tones and their locations in the spectrum. In other words, the db to PNdb conversion can vary appreciably, depending on the discrete tone content of the noise. This factor cannot simply be generalised, but is introduced in this paper as a possible additional disadvantage of increasing by-pass. The subjective situation may be a little nebulous at the moment, but in due course there will most probably be an accepted penalty. This will, most likely, be an empirical addition to the normally calculated PNdb value to allow for the annoyance of discrete tone content. The penalty will be one which increases with magnitude of protrusion and so there is an incentive to concentrate rather more on the blade passing tones than on the white noise.

**The cost of Noise Suppression** Usefully to ascribe a cost per db of noise reduction is difficult. In the 1.5 to 4 by-pass region, a 5db reduction in noise incurs an 8-10 per cent increase in specific fuel consumption. This is on the assumption that noise is reduced by lowering the by-pass ratio. There are other ways of tackling the problem.

The noise penalty for improved specific fuel consumption implicit in the previous estimates was due to increasing the fan tip speed to achieve a higher by-pass ratio. Consider keeping the fan tip speed constant by an appropriate lowering of the power turbine r.p.m.: in order to maintain the work output from the turbine and the thrust from the fan, it is necessary to provide more stages in both these components. This procedure increases the weight and cost of the engine. For example, for a by-pass of 4.0, an 8db reduction in noise would incur an 8 per cent increase in both weight and price of the engine.

The main point to be made is that noise is a factor to be weighed in the economics along with all the others between which interchange is juggled to suit the role of the aircraft-engine combination. In the absence of design innovation or new discoveries from noise research, quietness has a value which, somehow, has to be underwritten.

**Low-noise Fan** Returning to Fig. 2: the curves are based on actual engines, and show the upward trend of the all-important fan noise, which at first sight seemed inescapable without appreciable penalty. An important point is that both the current by-pass engines have inlet guide vanes and multi-stage low-pressure compressors or fans. The continuation of the fan noise trend assumes the presence of inlet guide vanes and/or stage multiplicity. But somewhere along the by-pass ratio scale there is a point where the required fan performance can be achieved with a single stage. In fact, this is in the region of 3.0 to 4.0.

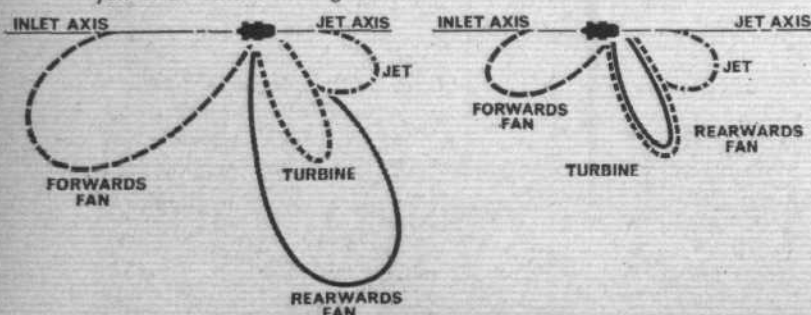
If the step to a single stage is taken, then by taking the additional design step of removing the inlet guide vanes it is possible to achieve the enormous reduction of fan noise indicated on the last chart of Fig 2.

The overall result is that the new high-bypass engine is considerably quieter than any of its predecessors.

The low noise-disposition of the single-stage fan without inlet guide vanes is explained in Fig 3. The main generating mechanism in a fan or compressor is the aerodynamic interaction of blades with the turbulence and wakes arising from the adjacent upstream row of blades. Reduction to a single stage leaves only two such interactions—inlet guide vane/rotor and rotor/outlet guide vane. The aerodynamic design can be such that the velocity on to the rotor is approaching three times that on the outlet guide.

The radiation patterns of a high-bypass engine compared with a multi-stage fan are shown in Fig 4. The extremely

Fig 4 The noise component field of high-bypass engines: left, with a multi-stage fan and inlet guide vanes; right, with a single-stage fan and without inlet guide vanes





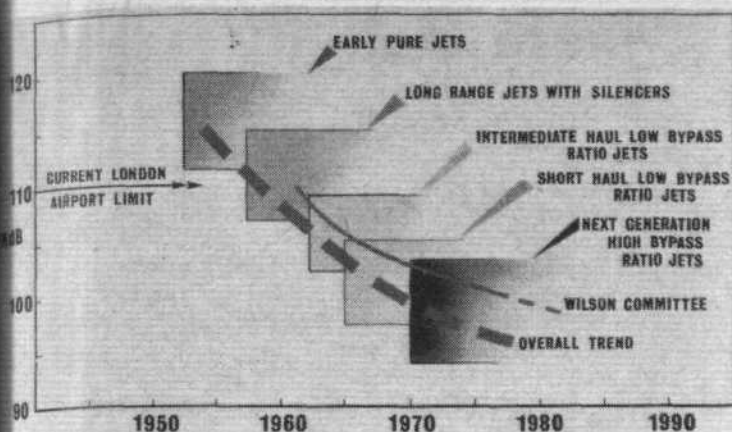


Fig 5 Reduction in aircraft noise levels during three decades

prominent lobe is that of the rearwards fan noise, besides which all other radiations pale into insignificance—especially the jet noise. Changing to a single-stage fan without inlet guide vanes greatly reduces fan noise generation at source, with a corresponding shrinking of the two fan noise lobes. Forwards fan noise and jet noise are now equally unimportant and the peak noise along a line parallel to the engine's centreline is determined by an approximately equal mixture of rearwards fan noise and turbine noise.

It may be readily appreciated that any further reduction of fan noise alone would be of little benefit. Complete elimination of the fan noise would leave very nearly the same noise peak constituted entirely by turbine noise. Continued effective progress requires simultaneous attenuation of both turbine and fan noise.

One way of achieving simultaneous reduction of fan and turbine noise is embodied in the Rolls-Royce design concept of a three-shaft engine. The fan and low-pressure turbine are carried on a shaft whose speed can be varied independently of the other two shafts—those of the high pressure and intermediate pressure systems. Thus the fan shaft can be slowed by reducing the area of the primary nozzle. The required engine thrust is maintained by compensating the loss of fan thrust with an appropriate increase in primary jet thrust.

## AN ERA REMEMBERED

**T**HE RETIREMENT of Harald Penrose from his post as Westland's group sales manager (writes a colleague) recalls the halcyon years of the British aircraft industry: years in which a small band of early test pilots played an important part in laying the foundations of the vast structure that was to arise during World War Two.

With contemporaries such as Chris Staniland, Cyril Uwins, "George" Bulman and P. E. G. Sayer, Harald Penrose flight-tested his full share of the huge number of prototype and production aircraft that were the forerunners of the weapons of victory. He was Westland's chief test pilot from 1931 to 1953.

Starting test flying in 1928, Hal Penrose joined the Yeovil company in 1926 after an initial period of attachment, as a university student, the year before. Receiving his aerial baptism with A. J. (now Sir Alan) Cobham in 1919 and ultimately qualifying as a pilot in the Reserve of Air Force Officers, in 1927, he logged nearly 6,000 hours of test flying in over 400 types and variants going as far back as the D.H.9, Bristol Fighter and Wapiti.

Probably the most significant aircraft tested by Penrose were the tail-less Pterodactyls, which he and Flt Lt Stainforth were the first pilots to spin and aerobat—but the full significance of the swept-wing configuration was not appreciated at that time. The prototypes most prominent in his memory are those of the Wyvern, in which three of his colleagues were killed during test flights. He had his closest call when a prototype Wyvern suddenly flick-rolled into an inverted dive following an aileron system failure at only 500ft—from which predicament he managed to recover and make a wheels-down landing.

To maintain total thrust the primary jet velocity has to increase, and the noise rises from complete insignificance to become, eventually, the predominant component at nozzle areas below 40 per cent of standard. The resultant total noise curve has a minimum when the nozzle area is about 50 per cent of standard. The noise benefit achieved at this optimum nozzle area for the particular engine power setting is 3PNdb. A similar minimum combination of fan, turbine and jet noise is obtainable at each thrust by selecting an appropriate nozzle area. The benefit, of course, decreases with increasing thrust, becoming zero at maximum thrust. However, up to 4PNdb is attainable at lower thrusts in the landing approach range.

To conclude, it is felt that the design concepts presented, namely single-stage fan without inlet guide vanes and the three-shaft engine, extract the maximum benefit from present knowledge gleaned from 20 years of persistent research.

Additional comparatively minor noise reductions can be achieved by application of acoustic filters or absorbers to both fan and turbine, but not without performance penalties. Continued energetic research, especially on blading noise, is required for further advances. To this end a special noise test facility is being provided in the United Kingdom. Basically this consists of a 6,000 h.p. drive for test compressors of 15in to 50in diameter and a very large anechoic chamber to obtain accurate far-field measurements without interference from the elements or ground effects. The construction of the facility is well advanced.

Fig 5 provides a final illustration comparing the progress in reduction of aircraft noise levels with a trend that appears reasonable for maintaining a constant overall annoyance level whilst the volume of air traffic increases. The piston-engined aircraft, being superseded in the 1950s, set the London Airport limit of 110PNdb. Pure jets would have been too noisy but the acceptance of a penalty from the application of silencers rendered them acceptable with the imposed limitations.

In the early 1960s the Wilson Committee reviewed the noise problem and carried out experiments to determine the influence of the number of exposures on the subjective effect of noise. One of their conclusions was that because of the anticipated increase in numbers of operations from 1961-1970, aircraft noise levels should reduce by 7PNdb in this period. This trend is matched by the early progress from the pure jet to the by-pass and by the recent transition in design to the high-bypass engine for the 1970s.

In the early post-war years Harald Penrose was a looked-for figure at flying meetings. His performance in the tiny Widgeon (equipped with a motor horn) is a memory that stays with many of us, as it did with him when he wrote (in *No Echo in the Sky*, following the untimely write-off of the last remaining Widgeon): "From the ashes no Phœnix arose—only ghosts of memories, and the haunting knowledge that there would still be other days and other flights, using this aeroplane and that, but none so loved as the little Widgeon."

Harald Penrose, man of many parts—test pilot, executive, author, ornithologist and builder of yachts—will, in the delightful Dorset village of Nether Compton, know that all his friends wish him a full life among his manuscripts, binoculars and boats.

Harald Penrose and his Westland Widgeon. With him is test pilot Flt Lt J. B. Thomson





# Lightweight Carriers, More Mobility

## THE AIR LEAGUE'S 1967 DEFENCE PROPOSALS

**M**AJOR MODIFICATIONS to the implementation of British defence policy, notably the increased use of seaborne air power and the cutting-down in size of overseas bases, are suggested by the Air League in its 1967 Memorandum on Defence\* published last week.

This 2,750-word document was issued at a press conference on January 25 presided over by the League's chairman, Sir Archibald Hope. It was introduced by Air Marshal Sir Douglas Morris, chairman of the League's four-man Defence Committee (other members: Rear Admiral A. S. Bolt, Mr R. Harker and AVM G. Silyn Roberts. Both Admiral Bolt and AVM Roberts, like Sir Douglas Morris, are retired officers; Mr Harker is military aviation adviser of Rolls-Royce Ltd).

The Memorandum, which is in eight sections, does not question British defence policy; it aims to suggest how the military role implied by that policy can best be carried out "within the limits of finance, manpower, and bases available."

The Air League notes four defects in current British military organisation: it is insufficiently mobile and adaptable (particularly with half the overseas strength of the British Army stationed on an almost permanent basis in Germany); with accommodation for families and dependants, the cost of overseas bases is inflated out of all proportion to their effectiveness; there is an unnecessary overlapping of aircraft between the Services when training and maintenance functions could be combined; and integration in Whitehall has not yet gone far enough to ensure an equal understanding of air power within each of the three Services.

### Doubts about the F-111

The Memorandum notes three prerequisite "essentials" for air power—the will and ability for offensive action; quality of equipment; and an aircraft industry capable of sustaining it.

Discussing the exercise of British air power in the 1970s, the League expresses disquiet as to the potential capability of F-111Ks in the Royal Air Force: "We do not think that the F-111 will be available in the numbers, and at short enough call, to provide the intimate close support which the Army and the Royal Navy must have from the Royal Air Force."

In the Government's 1966 Statement on Defence, which said that the Anglo-French variable-geometry aircraft would follow the F-111, the case was made for discontinuing aircraft carriers—on the grounds that the UK would not agree to provide another country with military assistance unless it was prepared to provide Britain with the necessary facilities [i.e., bases] to make such assistance effective.

In the Air League's view, this decision to discontinue carriers was "unfortunate to say the least"; and the Memorandum makes a case for what it calls "seaborne air power." There may be occasions when military action is contemplated and shore bases, in particular airfields, are not immediately available. Moreover, carriers have "that great military attribute, flexibility"; there could be times when "the freedom to move a compact air force might be invaluable." Carriers, with their radar, also supply what might well be "the only air defence organisation in the early part of an operation"; and they contain facilities to carry out "immediate maintenance of all aspects of the air force."

The League sums up its attitude to carriers thus: "Whilst it may have been necessary to cancel the large, expensive and limited-in-numbers carrier of the CVA-01 class, it seems that the need for smaller, simple carriers has not been fully argued. [Asked at the press conference how many of these vessels the Defence Committee had in mind, Sir Douglas Morris said they did not have access to Whitehall costings, but he thought five, six or seven.] With the advent of V/STOL aircraft the need for elaborate launching and landing gear will be largely removed and many economies in weight, subsequent size, and cost could surely be made."

Finally, the Memorandum stresses the principle of "mobility and economy of force" which (it says) should guide British defence planning. Units should be able to move with extreme rapidity to any trouble spot and to hit hard when they arrive. To this end, much greater mobility must be achieved; there must also be "a high degree of versatility and inter-Service co-operation within the armed forces."

If such principles are followed, says the Air League, certain fundamental changes will result: big static overseas bases will be eliminated in favour of hard-living, tough forces capable of moving rapidly to wherever they may be required; and overseas garrisons would be manned by units on rotation for a period of from three to six months.

In future, the Memorandum concludes, British air power must be organised in three principal elements: first, an intimate close-support or tactical force, using seaborne bases but designed to work with equal ability ashore or afloat. The ships envisaged, resembling existing Commando carriers and operating exclusively VTOL aircraft like the HS P.1127, would be complementary to land-based air power and their aircraft operated by both RN and RAF squadrons.

The second element would be what the Memorandum calls a "heavy strike and transport force," dependent on land bases; and the third, a support organisation including both maintenance and training, and opening up the way for further integration of the training and maintenance organisations of the three flying Services.

The Memorandum concludes:—

"In proposing seaborne air power, in addition to land-based air power, we realise that it was the rising cost of providing both which made the Government cancel the CVA-01 carrier class. From our previous arguments it will be clear that we do not consider that this should be an 'either/or' decision. Both types of air power are likely to be required in the future. To pay for them we advocate reducing the costs of overseas bases by discontinuing the location of married families overseas; by utilising the potential of V/STOL aircraft to reduce the size and cost of seaborne air power; and by streamlining the present structure to achieve economies particularly in pilot training and aircraft maintenance. The industrial key to solving these defence problems is manufacture of V/STOL types of fighting aircraft, of which the P.1127 is the first."

### "FIGHTING COCKS" HISTORY

"43 Squadron," by J. Beedle. Published by Beaumont Aviation Literature, 11 Bath Street, London EC1. Price £1 18s.

**F**ROM its formation at Stirling in 1916, No 43 Squadron ("The Fighting Cocks") has always considered itself to be the finest fighter unit of the Royal Air Force. It is not, then, surprising that Jimmy Beedle, in this most readable history, has taken great pains to prove 43's entitlement to that honour. No wanton claims are made, and after a short while the reader finds himself in complete agreement.

There is no hint of any piecing together of vague scraps of information from ex-members or from dry "540s" in the Air Historical Branch. Rather there is a feeling that the author was there to watch every event in person, whether in the days of the Sopwith 1½-Strutter, in a struggle with the Richthofen Circus during Bloody April in 1916, or with the Hurricanes in the Battle of Britain 24 years later.

The foreword is by Marshal of the Royal Air Force Lord Douglas of Kirtleside, who formed the squadron and was its first commander.

There are a number of splendid photographs, the value of which has been diminished by incompetent make-up. In some cases the captions are as far as three pages away from the illustrations to which they refer. The publishers, presumably, must accept responsibility for this one bad feature in an otherwise very good book.

J.Y.

\*Price 6s, postage included, from the Air League, 142 Sloane Street, London SW1.



## VIGNETTES OF VIETNAM—3

# BRINGING THEM BACK



One Kaman HH-43F local base rescue helicopter frames another at Da Nang with, in the background, an HH-3E "Jolly Green Giant" long-range helicopter used for rescue over both North and South Vietnam

**T**HE REMARKABLE ACHIEVEMENTS of the US search-and-rescue services in rescuing aircrews brought down in combat over North Vietnam are based upon techniques well proven 15 years ago in Korea and now made more effective by improvements in equipment. The penetration of North Vietnam by rescue helicopters ready to snatch downed aviators from possible humiliation and psychological damage and certain lengthy imprisonment is, in present circumstances, the headline-catching activity; but it is only one of several functions of the US SAR forces in the area.

Controlling the SAR forces is Military Airlift Command's 3rd Aerospace Rescue and Recovery Group, which operates an ostensibly tri-Service (but at present wholly USAF-manned) Joint Search and Rescue Centre in Saigon and Rescue Co-ordination Centres at Da Nang, further north in South Vietnam, and at Udon, in Northern Thailand. Third ARRG is charged with providing 7th US Air Force requirements for SAR throughout South-East Asia—in this context defined as North and South Vietnam, Laos, Cambodia, Thailand and the surrounding seas. Air rescue is not attempted by the American forces over the Chinese island of Hainan on the eastern side of the Gulf of Tonkin. The necessity for diplomatic clearance for US military aircraft to enter Cambodia could hinder rescue efforts, so SAR responsibility over Cambodia is contracted to the civil Air America group of companies, which has standing

clearance and retains suitable equipment. Air America assistance is also sometimes valuable elsewhere.

The Saigon centre and the two outstation RCCs are interconnected by single-sideband HF radio and direct hot lines. Aeronautical equipment operated by USAF elements of the overall SAR force includes the twin-rotor Kaman HH-43B local base rescue and crash fire-suppression helicopter at Saigon and Udon, with the improved HH-43F at Da Nang. The latter variant has a greater radius of action, some armour plating and more communications equipment.

TEXT BY ROBERT R. RODWELL

'FLIGHT' PHOTOGRAPHS BY TOM HAMILL

The helicopters earning the kudos for the lengthy penetrations of North Vietnam are Sikorsky HH-3E "Jolly Green Giants," developed from the USN Sea King ASW machine. Seven of these machines are based on Udon, with three at Da Nang, and expected in a few months' time is the arrival of a recently ordered variant which, among minor changes, will have greater tankage and an in-flight refuelling system.

Fixed-wing aircraft employed are the long-established Grumman HU-16 Albatross amphibian, which from Da Nang maintains a constant first-light to dusk standing patrol over the

The HH-43F has a crash-fire-suppression role over radii of about 15 miles from its base, and here one is seen hoisting the "meatball"—the fire-suppression kit. Flying "clean," and with a crew of different specialists, the same craft make aircrew recovery flights over radii of up to about 75 miles





## BRINGING THEM BACK...

The twin-engined HH-3E marries high speed and long endurance and has become the best-loved aircraft of many US and Vietnamese aviators, with rescue penetrations into North Vietnam as far as the Red River. The external fuel tanks on extensions to the spars are a field modification



Gulf of Tonkin, and (in Thailand) the long-range HC-130H Hercules, equipped with the scissor-like Fulton recovery system in the nose by which a man can be snatched from the ground and winched into the aircraft. The Fulton system has not been used operationally in South-East Asia for at least two reasons. The first is that it has only just concluded its qualification trials; the second is that it requires at least a 200ft-diameter clear area around the man being rescued—and in this area such clearings are rare.

Nevertheless, the HC-130H—with an endurance of 14hr, and developed with the tracking of returning space vehicles and the recovery of astronauts in mind—is proving very useful as an airborne search direction post over Thailand and Laos, and it is expected within months at Da Nang too. Its ultra-sensitive Cook Tracker, installed for the tracking of space vehicles, is outstandingly effective at detecting and locating radio distress signals, thus permitting other rescue aircraft to be homed in by the Hercules to distances at which their own less sensitive homing devices become effective.

Assigned directly to the SAR forces are a number of USAF A-1E Skyraiders, which mount a protective patrol over downed aircrews and escort rescue aircraft into hostile territory. The Skyraider, with its ability to absorb punishment, is ideal for suppressing ground fire in the area in which the rescue is to be made and for deterring ground forces from approaching the "client" too closely. In addition to the specifically SAR Skyraider force, JSARC has hot-line access to all other Skyraider operators, which include other USAF formations, the USN and the South Vietnamese Air Force, and it sometimes calls upon their aircraft. Fighter top-cover—"Mig Caps"—is sometimes required when aerial opposition is expected and is obtained on direct request to the C-130 airborne command posts which Tactical Air Command has in flight at all times. Standing fighter patrols are then vectored in to provide top cover.

More of North Vietnam is more easily reached from Thailand than from the northernmost bases in South Vietnam. Accordingly, many rescue missions are flown from Udon or from Nakhon Phanom, in North-East Thailand, which is supported from Udon. Daily, to reduce the reaction time of the Da Nang-based "Jolly Greens" over the southernmost portions of North Vietnam, two of the three HH-3Es fly the 75 miles north to Quang Tri, just a few miles south of the 17th

The USAF maintains a Douglas A-1E Skyraider force specially to fly rescue escort and rescue cap duties. Other Skyraiders are also called in for rescue duties if necessary, including those of the SVA, which operates the A-1H seen here



Parallel and the ostensibly "demilitarised" zone which is the frontier between North and South Vietnam. There they remain on stand-by all day, returning to Da Nang at dusk.

In addition to their role of providing constant daylight patrol over the Gulf of Tonkin for immediate rescue of ditched crews, the Da Nang HU-16 Albatross amphibians perform the same role in respect of the eastern area as do the HC-130Hs over Thailand—that of airborne rescue direction posts controlling rescue helicopters and escort aircraft. Their first-light-to-dusk constant patrol requires between 16 and 18 hours' flying daily, normally shared between two aircraft and involving full-weight, maximum-fuel take-offs from Da Nang. Prevailing conditions in the Gulf of Tonkin are such that for more than 90 per cent of the time sea states permit the amphibians to land and take off. At night one Albatross is maintained on stand-by at Da Nang.

The Kaman HH-43B and -F were initially procured for local base rescue efforts, involving the immediate suppression of crash fires. In this role they operate with two pilots and two firemen and immediately after take off hitch-up and convey as an external load the bright-red spherical fire suppression kit. Rarely is such a mission undertaken further than 15 miles from base, since at greater distances a crash fire is likely to be beyond the power of a mere fire suppression vehicle to combat. At radii of up to about 75 miles, however, the same helicopter is an effective aircrew recovery vehicle, in which role its crew comprises two pilots, a winchman and a para-rescue man who is a trained parachutist, scuba diver and medical attendant. HH-43s at readiness, therefore, have the fire-kit alongside them on the hardstanding and, in the adjacent crew-readiness trailer, personnel to make up either kind of crew are on stand-by. On being scrambled, the appropriate crew for the sortie mans the aircraft and it departs either with the fire kit or "clean," as the case may be.

Expensive and relatively vulnerable SAR aircraft are not exposed to the hazards of operations over North Vietnam unless there is confidence that rescue is reasonably certain. The decision will normally be based upon reports by a downed aviator's wingman that he has seen a successful ejection, followed if possible by reports that he has seen the man safely on the ground and that he is marking the spot. The normal practice is for the wingman to orbit at least until a rescue cap reaches the area. If necessary the wingman will be vectored to an in-flight tanker for refuelling, and will then return to his orbit. Night rescues are not at present attempted over North Vietnam; but forthcoming advances, both in helicopter equipment and location devices, make them a probability in the near future. Meanwhile, if a flier is shot down at night, or too late in the day to make rescue possible, he is urged to hide through the night and rescue is attempted at first light.

In those cases where ejection is premeditated and not an immediate necessity, aircrews are briefed to choose the venue from a list of diminishing chances. Virtually total American air and surface superiority over the Gulf of Tonkin places this at the top of the list as the best bet, the slight risks of drowning attendant upon baling out into the sea, or ditching,



being more than offset by the lack of a hostile reception and virtually 100 per cent chances of rescue. Of the land areas, Thailand offers the best prospects of a friendly reception on the ground, with the third choice certain defined "safe areas" in Laos, which by no means cover the country. North and South Vietnam are at the bottom of the list—if ejection into either of these countries is inevitable the best choices are, obviously, isolated areas and particularly the more elevated regions. The hill and mountain regions are, of course, more sparsely populated than the lowlands; in addition to this the hill people, the Montagnards, even if Communist sympathisers, tend to be more friendly than their lowland counterparts.

Location devices carried by aircrews naturally tend to locate them, not only for their aspiring rescuers, but for the enemy. (A further reason for not using the Fulton system is that it involves the raising of a tethered helium balloon and thus provides a good vector for searching Communist forces.) One location aid is the URT-21 UHF "beeper," carried on the parachute harness and triggered on baling out. But no great reliance can now be placed upon this device, since the Communists have used captured examples in attempting to set up helicopter traps. The shot-down airman is, therefore, briefed to switch immediately on landing to his survival-jacket-mounted RT-10, which adds an R/T speech function to the beep, much in the same way as does the British Sarbe set. With the RT-10 the airman is able to speak immediately to his wingman or top cover to confirm his safe arrival on the ground; and, if the landing is in dense jungle or high reeds and grassland, the airman can provide homings by ear for the helicopter once it reaches his immediate area.

Other location devices carried in the survival jacket are a heliograph mirror and a two-second-flash electronic strobe light for last-minute, immediate-area location. The strobe light had the drawback of having, on some occasions, appeared to rescuers as small-arms fire, thus tending to deter them. Now a coloured screen can be placed over the light, making its flash distinctive and also serving partially to screen the flash from the sight of ground troops.

### Winching Through Trees

The jungle areas in South-East Asia are both high and thick. To penetrate dense foliage with the rescue hoist, helicopters carry, in addition to a conventional strop, a bullet-shaped penetrator to mount on the end of the cable. This 40lb device can be dropped down through the trees to ground level, where three leaves at the bottom of the bullet fold out to make seats. Safety straps are unzipped from the top section. Dependent upon the winch capacity of the helicopter, up to three men can ride the penetrator at one time. Height of jungle trees dictates that rescue choppers carry at least 200ft of cable. The normal practice is to encourage men landing in the tops of high trees to stay put and enjoy the cover conferred by the foliage; then they are lifted straight off their perches. In some circumstances, however, it may be necessary for them to descend, and aircrew normally carry abseiling packs to lower themselves to the ground should the need arise.

The Da Nang "Jolly Greens" operating from Quang Tri rarely go further than about 100 miles north over the 17th Parallel demilitarised zone. As mentioned earlier, much of North Vietnam is more easily reached by these long-endurance (6½hr) and relatively fast helicopters from Thailand. From Thai bases they have successfully made rescues as far north as the south bank of the Red River, North Vietnam's main riparian artery. On the eastern, seaward flank of this hostile country, US SAR forces naturally fly as much as possible over the Gulf of Tonkin before penetrating inland. Rescue attempts are scarcely worthwhile for any crews shot down in the densely populated lower valley of the Red River, in the metropolitan Hanoi-Haiphong complex, since their immediate capture by North Vietnamese is almost inevitable. None the less, USN UH-2B Seasprite helicopters operating from vessels in the Gulf, and fully integrated with the JSARC network in Saigon, have made rescues from seaward in the northern coastal regions of North Vietnam.

On the precise nature of the forthcoming improvements in the South-East Asia SAR organisation the men involved are understandably loth to comment, save to repeat the already



The 37th Air Rescue Sqn at Da Nang operates Grumman HU-16 Albatross amphibians to rescue fliers baling-out or ditching into the Gulf of Tonkin. Taking off is a Pilatus Turbo-Porter of the Air America charter company, which has some air rescue commitments in SE Asia

announced fact that forthcoming "Jolly Greens" will have an in-flight refuelling system and other small improvements, and that some HC-130H Hercules are expected at Da Nang in the near future. To make possible the extension of helicopter rescue to the night hours, rather than give shot-down airmen the unenviable task of remaining hidden from hostile forces until dawn, demands not only advances in the airborne equipment but, presumably, in the aircrew's own location devices. In the overall counter-insurgency context much American research is being devoted to night vision devices, which would seem to have obvious applications in SAR.

The sturdy Albatross, a standard US workhorse since the late 'forties, maintains from Da Nang a standing patrol over the Gulf of Tonkin during all the hours of daylight. Crews fly to Thailand for waterborne continuation training in freshwater areas, to avoid corrosion problems attendant on operating unnecessarily from the high-salinity Gulf







Three production-standard HFB 320 Hansa business jets on the flight line at the Torrejon, airfield, near Madrid where certification flying is now nearing completion. Four HFB 320s are now flying; recent external configuration changes include the fitting of boundary-layer control fences on the wing and tailplane

## SPORT AND BUSINESS

**National Air Racing** At last week's Royal Aero Club dinner to John Miles, the 1966 British Air Racing Champion and winner of the King's Cup, details were announced of the events to comprise the 1967 national air racing calendar. The main change in form is that after 11 years of King's Cup races at Coventry the premier event of the season is to be flown round a new course at Tollerton Airport, Nottingham. The race will take place on August 19 in conjunction with an international flying display. Qualifying rounds for the King's Cup will be held at Plymouth Airport (July 22), and Tees-side Airport (August 5). At the Tollerton meeting there will be a special race for helicopters, sponsored by the Helicopter Club of Great Britain. A notable feature of the 1966 season was the participation by a Surrey and Kent Flying Club team flying Chipmunks, of which John Miles was the captain; and, to encourage other clubs to enter in force, the Grosvenor Challenge Cup is to be revived for award to the best team in this and future national air race seasons.

For the time being the Royal Aero Club has refrained from introducing any new format in the national races themselves, which remain of the open handicap variety. Perhaps next year will be the right time to introduce formula scratch racing as well. The air-racing fraternity is keen to have closed-circuit scratch racing between aircraft complying with a fixed upper capacity limit on the powerplant of, say, 250 cu in. Such a capacity would embrace all popular production engines in the 100-120 h.p. bracket. Pending the arrival of special aircraft the new kind of scratch racing could even begin this year (with the Goodyear Trophy?) as there are enough standard training and touring aircraft in the proposed popular power category. Nevertheless, four eminently suitable types may well be flying within the next few months—the Rollason Beta, the Taylor Titch (already, in fact, airborne), the Goodwin J.G.3 and the Mitchell-Proctor Kittiwake; all were evolved from entrants in the 1964 Rollason midget racer design competition.

Closed-circuit scratch racing arranged in short heats between

four or five machines, plus a final, would provide more spectator appeal than does the present style of racing. Aided by a top-class flying display, such a meeting should have enough publicity value to attract adequate financial backing; and good prize money and starting money should justify the preparation of special racing aircraft. Technically, too, it would be a valuable stimulus to light aircraft and engine design.

**FAA Proposes 75-hour Instrument Rating** To improve the skills and proficiency of pilots, and to promote safety, the Federal Aviation Agency has proposed a new "Basic Pilot Certificate" and higher standards of training for the private and commercial pilot licences. It is intended that the certificate shall satisfy the modest needs of pilots who just want to fly relatively simple types of aircraft for pleasure on VFR/VMC occasions. It would require a mere five hours of cross-country solo flying, and the granting of the certificate would rest entirely with the instructor.

Although the "basic" pilot would be allowed to carry passengers he would be restricted to daylight operation and to conditions of 1,000ft cloudbase and visibility of at least five miles. "Relatively simple types of aircraft" are visualised as those with fixed-pitch propellers and fixed undercarriages, and without wing flaps.

The FAA also proposes to raise the standard of the private pilot licence by increasing the requirements of flight training and experience from 40hr to 75hr. The FAA hopes that "the up-grading of the private pilot requirements could, with careful planning of flight and ground training, result in the private pilot being eligible for an instrument rating with no additional flight time." Present regulations require at least 200 flying hours before application is made for an instrument rating. Changes to the commercial pilot certificate require 250hr of flight experience (50 hours more than at present), plus an instrument rating. Comments on the proposals are to be made to the FAA before April 13.

General aviation is said to be in favour of the proposed regulations though, as in Britain, the commercial flying community will doubtless object to any apparent easing of the instrument rating requirements.

Similar proposals have been long under consideration in Britain by the Ministry of Aviation (and now by the Board of Trade) under the promptings of the combined "PACFAG" committee comprising representatives of the governing bodies of general aviation. So far there appears to have been no significant progress towards either an "IMC rating" or a tailoring of the instrument rating requirements to the encouragement of general aviation. In fact, a year ago the attainment of an instrument rating was made even more difficult for the British private pilot by the requirement that all training had to be during full-time attendance at an approved course.

Jim Dewey, an FAA supervisory inspector from Santa Paula, Calif, spent six years in designing and building this rakish all-metal tandem two-seater named Dewey I and powered by a 150 h.p. Lycoming O-320. The wings were built on Tony LeVier's Cosmic Wind jigs; the steel tube fuselage is skinned with light-gauge aluminium; speed exceeds 200 m.p.h.





**BWPA Awards** Young women pilots are to be given more help in their flying careers by a fund set up to commemorate the achievements of that great woman pilot Amy Johnson. The Amy Johnson Memorial Scholarship Fund, which provides for professional flying training for young women, was handed over to the British Women Pilots' Association on January 21 by the Women's Engineering Society, which has hitherto administered the fund.

On the same occasion the BWPA presented their star member, Miss Sheila Scott, with an illuminated globe in recognition of her record-breaking round-the-world solo flight last

year. The association has also honoured the Australian pilot, Miss Rosalind Merrifield, by the award of the Jean Lennox Bird Trophy for her three solo trans-Pacific flights.

**A Vintage Evening** is planned for February 17 by the PFA and its Vintage Sport Aviation section. The programme, at the Kronfeld Club, will include a talk by the well-known replica-builder for films, Mr Douglas Bianchi, and the showing of two films, one of which is to include flying excerpts from *The Blue Max*. The Denis Fry Trophy and the John Edwards Memorial Trophy will also be presented.

## WHY NEGLECT THE AUTOGYRO?

**T**HAT "the autogyro can score a major breakthrough in the lucrative private aircraft market..." was the view expressed in a recent paper\* by Mr F. H. Robertson, chief of preliminary design, Short Bros & Harland Ltd. He said that in many parts of the world, including Britain, privately owned light aircraft were a dubious asset, owing to the shortage of airfields and the unpredictable weather. He could visualise a healthy sale for a range of autogyros with VTOL performance; they would also be inherently easier to fly than an aeroplane, could not stall, and could be flown under the weather. Compared with a helicopter, the autogyro could be cheaper, and free of unsafe characteristics in vertical flight near the ground.

From the first practical attempt to fly an autogyro (by Juan de la Cierva in 1919) more than 60 types of experimental machine have been built during the intervening years without commercial success. Mr Robertson did not deny that there was room for doubt as to whether the type of vehicle is in fact worthy of development. Asking where the future of the autogyro lay, he pointed out several significant factors: The freewheeling rotor represented the minimum power and minimum noise solution to the VTOL problem—albeit not the minimum weight solution. At cruising speeds a rotor created a lot more drag than an equivalent fixed wing, but an autogyro rotor had less drag than a helicopter rotor and could work to higher speeds before serious trouble occurred with local blade stalling (the flow through an autogyro rotor being upward through the disc, the retreating blade-root stalled first; in a helicopter, with downward flow through the disc, the retreating tip stalled first). An autorotating fixed-pitch rotor cannot stall.

Mr Robertson considered that, while contemporary knowledge was sufficient for satisfactory autogyros to be built now, there were a number of fields in which further research and development should bring reward. These he listed as follows:

**"Rotor Control"** The fundamental question which needs answering is whether the rotor should be articulated, semi-rigid or rigid and whether, if either of the first two systems is used, rotor control should be by axis-tilt or by cyclic-pitch control. In the case of the rigid rotor, of course, cyclic pitch control is the only known solution. There is no doubt that the rigid rotor offers greater forward speed potential and the hope of getting a measure of static stability. On the other hand, the semi-rigid rotor is probably the easiest and cheapest to design. A well-organised study of the whole subject is needed.

**"Control Range and Flight Safety"** The autogyro is very easy to fly, but it and the helicopter are suspect in their behaviour under certain extreme dynamic conditions. Nowhere near enough work has been done on this subject. As with fixed-wing aircraft, a case can be made for limiting control power to a level which prevents the pilot from entering a dangerous condition; but this approach always leaves the unattractive loophole that it might prevent recovery from a situation caused by circumstances beyond the pilot's control.

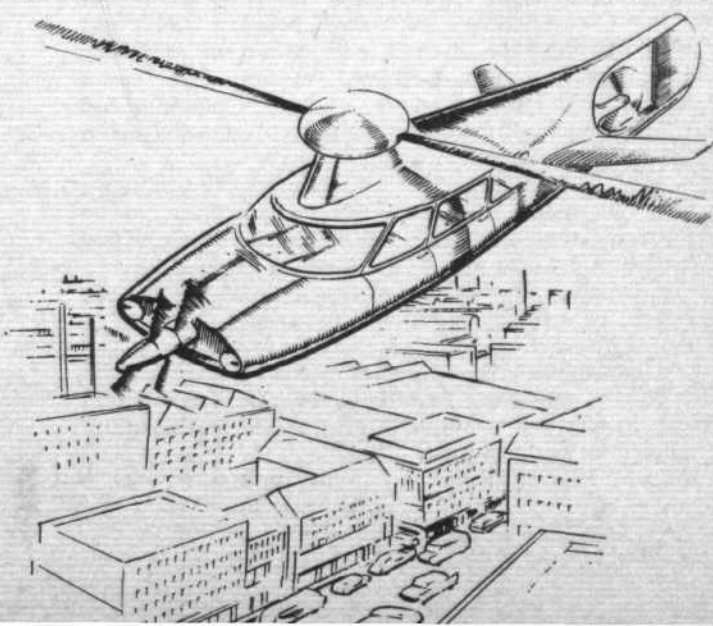
**"Power Transmission and Torque Balance"** On the simple autogyro without VTOL ability there is no problem other than

the need for integrity and a low vibration level during spin-up. Once VTOL is attempted the whole system becomes more complicated and needs a well-organised study. Compressed air rotor drive by jet or ribbon efflux is very attractive, due to the absence of torque transfer; but there are problems, not the least of which is the fact that the optimum blade section is not large enough to pass the quantity of air needed. However, when one examines the automatic transmission of a modern car and experiences the smoothness and effectiveness that has been engineered into it at a remarkably low price, one must be optimistic as to the chances of similar success with transmission sharing power between propeller and rotor.

**"Engines"** To achieve useful load carrying and speed, I believe that the personal autogyro needs at least 100 h.p. per person. If one takes 125 h.p. as the target, and assumes that single-seat and two-seat machines would be single engine whilst four-seaters would be twin engine, so as to ensure safety over built-up areas, then what seems to be needed is a 125 h.p. engine and 250 h.p. engine with a large number of common parts. Until turbine manufacturers come down from their current astronomical price level, turbine engines can be dismissed. Piston engines, or something like the NSU Wankel, are almost certainly the answer. The most modern piston aero-engines are nothing short of antiquated in design when compared with modern motor-car and, more especially, motor cycle engines, in almost every detail. Both the Italians and Japanese produce racing engines which turn out nearly 200 h.p. per litre capacity. These engines have double overhead camshafts, four valves per cylinder, highly refined port and cylinder head design and very low weight. By comparison, current aero engines produce about 36 h.p. per litre.

"I do not suggest that anything approaching the road racing engine's performance should be used; after all, safety and reliability are of first importance. An ordinary road-going Italian or Japanese machine is, however, producing something like 80 h.p. per litre—more than double the output of a modern aero engine. Surely there is a field here which would be worth exploring."

A four-seater with power transmission shared between the propulsive drive and the lift rotor (to give VTOL with full control) is the most ambitious advanced autogyro foreseen by Mr Frank Robertson, whose paper on the state of the autogyro art is summarised on this page



\*Short Brothers Commemorative Lecture 1966, entitled "Autorotating wings—theory, history and future possibilities," by Mr F. H. Robertson, CEng, AFRAeS, FBIS, delivered before the Royal Aeronautical Society's Belfast Branch.



# Letters

## The Vanguard Accident Report

SIR,—I also have been following the correspondence regarding the Vanguard accident inquiry, and in my opinion the use of the term "airline error" or "designer's error" is just as general, if not more so, than "pilot error." The fact of the matter is that the use of such terms is to be avoided as much as possible, as they carry a different meaning to each and every individual.

I think it would be fitting at this stage to quote the accident report itself (page 44): "There was here a series of misfortunes which combined to bring about the eventual crash. No single one of these on its own would have caused the accident."

This means that no single factor by itself would have caused an accident and that, in an assessment of this nature, *everything* must be taken into account. In the case concerned the pilots acted on what they believed to be reliable and accurate information. The fact that an approach, or approaches, were carried out was not due to "so-called" airline error, as the crew believed that they were operating within the correct minima, just as ATC probably believed that they were giving the aircraft correct information.

West Bridgford, Notts

ROBERT G. P. TAYLOR

## Duty-free Freighters

SIR,—After reading Ian Griffin's letter (December 22) and Nigel Thompson's most informative and illuminating reply (January 5), I think it is about time the question as to whether or not BOAC pays import duty on its American-manufactured fleets—past and present—was settled once and for all.

First, Mr Thompson is perfectly correct in his assumption that the corporation's original fleet of 20 (now 19) 707s were imported duty-free. If interested readers care to do so, I suggest they turn up your issue of May 13, 1960 (pages 657-660) and May 23, 1963 (pages 742-743) wherein will be found all the vital facts and figures concerning BOAC's contracts with Boeing in regard to these aircraft.

Secondly, the "special privileges" which BOAC has enjoyed (thanks to all previous Government concessions), regarding the importation of its formerly distinguished fleets of American airliners, have to the best of my own personal knowledge had the normal import duty (levied on foreign-built aeroplanes) waived, by full agreement of HM Customs and Excise as well as by the Treasury.

For the record, the previous types and numbers of aircraft involved are as follows:—

1. A combined total of no fewer than 16 L.049 and L.749 Constellations, purchased between 1946 and 1954. Of these 16 aircraft, only five were originally purchased new from Lockheed, the remainder being second-hand from various sources, including five L.749s acquired from the defunct Aerlinite Eireann (Irish International).
2. A total of 17 Boeing 377 Stratocruisers. Ten of these were purchased new from the manufacturer, whilst the remaining seven were second-hand, coming from United Air Lines and Pan American respectively.
3. Ten Douglas DC-7Cs (Seven Seas), all of which were bought new from the manufacturer, and delivered in 1956-57.

It will therefore be clearly seen that BOAC (at the poor old UK taxpayers' expense in the past 20-odd years) have been afforded a unique privilege. And that's putting it mildly, to say the least.

Nairobi, Kenya Republic

DENNIS M. POWELL

## Wrong Link?

SIR,—With regard to Roger Bacon's recent remarks about governmental folly, surely the most egregious example of this is linking the British aircraft industry with the French. It would be better surely to link with the German industry, which has had a tradition, during and since the war, of inventiveness on less money. Moreover, the Germans—unlike the French—are internationally minded.

Redhill, Surrey

P. WOOD

## What Australia Wants

SIR,—I do not wish to give the impression that I am very experienced in the complex world of the British aircraft industry, but it seems to me extraordinary that one project in particular seems doomed to the design stage for ever.

Stanley Brogden, in his article "Australia's Re-equipment Problems" (page 79, January 19) refers to the fact that Mr Ansett, of Ansett-ANA, would place an order immediately for the HS.136 if it went into production.

BAC and BUA worked together to tap the vast market with the BAC One-Eleven; surely Hawker Siddeley and Ansett could be a new Edwards/Laker. Certainly the financial risk would not be as great as that of the One-Eleven, and it seems to me that it stands as good a chance of success. If Ansett needs the HS.136 surely TAA and the smaller airlines—MMA, East-West and Airlines of NSW—might buy it.

Even the Government could not have too much objection to a project like this with a high chance of success.

At least—please, please, please, for the sake of our aircraft industry—take a closer look into this possible market.

Liverpool 9

R. W. C. KELLY

## Not the Hoskins...

SIR,—For some considerable time my colleagues and myself have been amused and intrigued by Roger Bacon's illustrations of the accidents, incidents and *faux pas* of my alleged relations in the world of aviation.

But this time, Sir, he has gone too far! From May 1964 until February 1966 I was employed by the Royal Air Force as a mountain flying instructor at the CFS Detachment in Anglesey. Dammit, man, I *flew* XP344 in those hills!!



I am desolate; all the sins of my relations are laid at my doorstep. My present students look at me askance; they furtively search my log-book for evidence of my misdemeanours—and I have never *flown* a Swordfish, Crusader, etc.

Please change the name, or furnish me with some proof that all save the last are not *my* responsibility!

RNAS Culdrose,  
Cornwall

J. W. HOSKINS,  
Flight Lieutenant, RAF

## Yeovilton Attraction

SIR,—The Fleet Air Arm Museum, here at Yeovilton, reopens on March 17 for the 1967 season and, as described in Cdr Nicholas' letter (*Flight*, December 16, 1966) pride of place goes to our interesting new acquisition, the Supermarine Walrus.

Last year we had well over 40,000 visitors and this



year we expect even more, as the reputation of the museum is spreading overseas as well as all round Britain. A popular attraction has been the car park, into which travellers on the A303 can easily slip to watch the flying.

Much of the detail in the exhibits has come through help from casual visitors and others who have heard indirectly of the museum's work. I would be most grateful, therefore, if any of your readers who have Royal Naval Air Service/Fleet Air Arm relics, mementoes, photographs and so on, and which they feel might have a place as exhibits or in the archives, would get in touch with the Curator. Should they care to come in person, they will be assured of keen interest and a cordial welcome.

RN Air Station,  
Yeovilton, Somerset

G. C. BALDWIN,  
Captain, RN

### Ditched Dart: the Last Word

SIR,—In connection with recent correspondence on the "ditched Dart" it may interest you to know that the same picture, much enlarged, occupied the whole of the front page of *The Sphere* for May 17, 1930. What must surely be the last word on the subject went to their caption writer who, with complete disregard for geographical considerations, described it as "Awaiting Rescue 1,000 miles from land in the Mediterranean Sea."

I have followed the subject with more than average interest as I am at present writing a book on Blackburn aircraft in the Putnam series and am anxious to get in touch, through your columns, with former Service pilots who flew, or have photographs of, Darts and Blackburn Blackburns on carriers, or who were engaged in testing the many Blackburn prototypes evaluated at Martlesham and Felixstowe before the war.

29 Olivia Drive,  
Leigh-on-Sea, Essex

A. J. JACKSON

### Meteors in War

SIR,—In the book, *Wheels, Sails and Wings—the Story of Transportation* (Golden Press, New York) it is stated (page 83) that "... Germany was the only nation to have jet planes in combat in World War II."

I am sure this is wrong. Did not the Gloster Meteor engage in combat?

El Segundo, Calif

A. PATTERSON  
(late of Liverpool)

[It depends on the definition of "combat." Meteors were certainly in action against flying bombs and, over occupied territory, against ground targets; but they were not, we believe, engaged in any air-to-air action—Ed.]

### Aged in the Wood

SIR,—I was very sorry to see in "Sport and Business" (*Flight*, January 19) your paragraph on old wooden aeroplanes, with reference to ARB Notice 67. If the staff member who dealt with this notice had been doing his homework properly, he would have seen that Notice 67, printed on blue paper, is simply a reprint of *Notice to Licensed Aircraft Engineers No 67*, dated May 13, 1963, and printed on white paper, and does not represent further thoughts on the subject. It is part of the revision of the Air Registration Board's file of notices to licensed engineers and owners of aircraft.

I feel that a little space should be devoted to clarifying this situation, because it will be one more excuse for those people who are anxious to pull all the old aeroplanes to pieces. I think, too, that your readers, and anyone interested in aircraft structures, should be told about the tests made at Cranfield on Gemini and Proctor wings, which I am sure helped the board to take a more lenient view and gave all the old wooden aeroplanes a potential life extension.

The whole situation arose from the premature use of synthetic glues during the late war years and up to 1950, before these particular types of glue were properly developed, and before the method of using them was

fully understood. There are a number of pre-war casein-glued aircraft in remarkably good condition, a fact which I attribute to the nature of the glue, which had to be used within an hour of mixing, and to the skilled craftsmen who built pre-war aeroplanes.

If anyone is really interested in the durability of box-spar construction, particularly of Miles aircraft, let him scratch around the backs of hangars on airfields where there are a lot of light aircraft, and he will probably find old Miles Magister and pre-war Proctor main spars lying in the open. I did my own personal glue inspection of such a spar over a period of three years, and the glue was still sound at the end of that period, although the spar was in the open and lying on wet ground. When one looks at the massive proportions of the main and rear spars on the Miles Hawk series the idea of limiting these aircraft to Rate 2 turns is ludicrous. As has been proved with Messenger and Gemini spars assembled with the bad post-war synthetic glues, these spars have a respectable safety factor even when the glue has almost given up its job.

Wood in good condition is the perfect material for light aircraft construction, because it doesn't fatigue. The snag is that there isn't enough of the right kind. With modern glues it could still give metal a run for its money in light aircraft construction, as the French are proving so well. Quite frankly, I cannot see some of the current American light aircraft with their 18 s.w.g. light-alloy spar webs lasting ten years, let alone 30 years. And have you seen the bills when the "corrosion proofed" structures corrode and the wings have to be reskinned?

Leamington Spa,  
Warwickshire

EDWARD EVES

### Pooling Agreement?

SIR,—I know BEA wanted the 737, but aren't Boeing stretching a point with that registration? (*Flight*, January 19, page 77).

Halifax, Yorks

PHILIP E. LYON



### Northolt Mystery

SIR,—First, thank you for those magnificent features in the Christmas issue of *Flight*, particularly the pictures of those Vildebeests in 1938 and Carden-Baynes story. Sadly, I am too young to have known those years.

Secondly, a question. I have found on record that one or two years after the 1914-18 war a "giant" Russian biplane bomber was stranded at Northolt aerodrome. The bomber landed and never took off again; perhaps it was raided for spares. Does anyone remember it? Was anyone there? All I know is that it was parked at the end of the runway, by a wood, for two years.

Axminster, Devon

NICHOLAS PEARKS

### IN BRIEF

In Northern Ireland on Friday and Saturday, February 24 and 25, No 210 Sqn is celebrating its fiftieth anniversary, and events to mark the occasion will include an "open morning" (on the Saturday) when guests and families will be able to see a parade, and a static display of aircraft, equipment and historical exhibits. In connection with the anniversary the squadron wishes to borrow (for copying and safe return) relevant photographs and documents: they should be addressed to Flt Lt J. Barron, No 210 Sqn, RAF Ballykelly, Limavady, Northern Ireland.



# INDUSTRY International

## Products

## Company News

**Phantom Radio Altimeters** McDonnell Aircraft Corporation has ordered Standard Telephones and Cables' STR.70-P radio altimeters for the Phantom F-4K and F-4M aircraft which will be supplied to the Royal Navy and Royal Air Force.

Worth approximately £210,000, the order is expected to be the first of a number to be given by McDonnell for the STR.70-P, which is already scheduled for numerous military aircraft—including the Hercules C-130K, HS.801 Maritime Comet, Sikorsky SH-3D Sea King helicopter, Andover, Wessex and F-111.

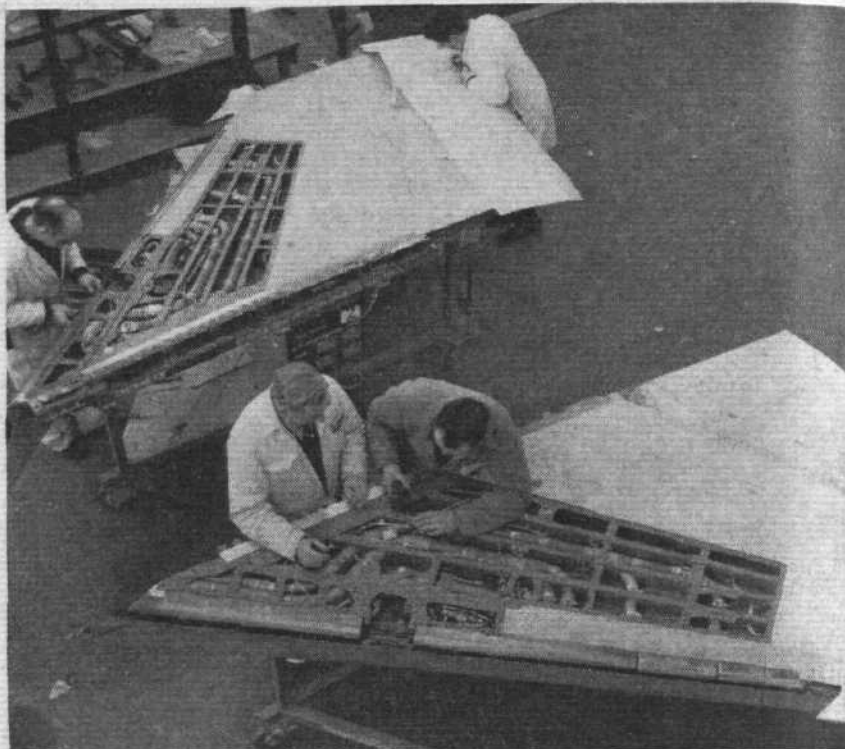
The STR.70-P, claimed to be the world's first fully solid-state micro-miniature radio altimeter, has been wholly developed by STC's Radio Division. It is a frequency-modulated device employing monolithic integrated circuits to ensure maximum reliability. Designed for low-level operation, it is capable of being turned to use for operations such as terrain following, low-level strike, low approach, automatic landing and autohover.

**Bendix in Chilean Hunters** FieldTech Ltd, UK Distributors for the Bendix Corporation, have received a contract from Hawker Siddeley for the supply of Bendix Avionic equipment for the 21 Hunters being built for the Chilean Air Force. The equipment consists of dual RTA-41B extended-range VHF transceivers, single RNA-26C navigation receivers and single DFA-73A ADF receivers. Each system incorporates solid-state switching and complete transistorisation, with the exception of the output stage of the RTA-41B.

*A plastic observation dome for the Lockheed Hercules receives its final inspection at English Electric's Luton factory. One of a batch of cupolas ordered for the Hercules aircraft being built in the USA for the RAF, the complete assembly consists of a transparent dome formed to close tolerances from acrylic sheet, set in a glass-fibre ring with built-in ducts for hot air demisting*



Short Brothers and Harland Ltd finished the first pair of McDonnell Phantom outer wings, complete with leading-edge flaps, two weeks ahead of schedule, and shipped them to the United States last month. An order for an initial batch of Phantom outer wings was placed with the company at the end of September 1965. Since then the number of parts ordered has been substantially increased, and Phantom work at Belfast is expected to last for at least another two years.



**Rubber Flooring for Jetway** Approximately 2,000 sq ft of Widerib Rubber Flooring, manufactured by the Runnymede Rubber Co Ltd, Staines, Middx, has been installed in the new Jetway adjustable passenger gangway at Dublin Airport (illustrated on page 744 of *Flight* for November 3, 1966).

The wide ribs provide a non-slip surface on the slopes, and a border of plain rubber flooring on each side facilitates cleaning of the ribbed area.

**New Kienzle Printer** Radiatron (7 Sheen Park, Richmond, Surrey) announce that the Kienzle digital printer Type D4—designed to print out from binary coded decimal information without the need for additional electronics—can now accept a minimum voltage difference of 2V between the "0" and "1" states. It can, therefore, print out from integrated circuits directly. The number of digits which can be printed has been increased from 14 to 16. This printer can be supplied, as can the types D11 and D14, as a bench-mounted model for strip printing; with a wide carriage; or as a 19in rack-mounted unit.

## IN BRIEF

BOAC has ordered a second Hawker Siddeley Dynamics TRACE (tape-controlled recording automatic checkout equipment) to extend its testing of electronic components on VC10s and Boeing 707s. (PAA order: see pages 152-153.)

The London School of Flying is being appointed a dealer in Piper aircraft. Included in the franchise are agencies for Narco and King radio equipment.

Theta Instrument Corporation has moved from Saddle Brook, NJ, to 22 Spielman Road, Fairfield, NJ.

The AC Electronics Division of General Motors Corporation, Milwaukee, Wis, has been selected to develop and manufacture the Carousel 4 inertial navigation system for the Boeing 747.

The Constantine Group of Companies, York House, Middlesbrough, Yorks, has acquired from Cope Allman International Ltd two more companies in the export packing field. The new acquisitions are Lloyd's Machinery Packing Ltd, of Manchester, and John Stevenson & Sons Ltd, of London.



## PEOPLE AND POSTS

Mr Kenneth C. Saltrick has been appointed to the post of production manager of Flight Refuelling Ltd.

Mr G. A. Lemon is promoted from controller to general manager, operations, of Sperry Gyroscope Co Ltd, retaining his seat on the board. Mr J. B. C. Darroch has been appointed to the post of controller.

Mr F. E. Osborne, engineering manager of Rolls-Royce's Hamilton factory for the past five years, has been appointed manager of Spadeadam Rocket Establishment in succession to Cdr J. W. Adams.

Sir John Paget has been appointed to the board of Hilger & Watts Ltd as production director; Mr J. R. Stansfield has been made technical director; and Mr R. Stanley retires from executive duties as sales director but is remaining on the board and acting as consultant. His responsibilities for home sales have

been assumed by Mr W. Bamford, as general home sales manager. Mr F. Hamill is to be appointed managing director of a new subsidiary, to be known as Hilger & Watts International Ltd.

Mr David Van Alstyne, Jr, has been re-elected to the board of Lear Jet Industries Inc.

Mr J. Roy Gordon has retired from the post of president of the International Nickel Co of Canada Ltd, but remains on the board. Mr Albert P. Gagnebin has been elected president and Mr James C. Parlee, senior executive vice-president.

Mr R. G. Woodward has been made group chief inspector of motor car and aircraft glasses for the Triplex Safety Glass Co Ltd.

Mr Gerald D. Gilmore has been named marketing manager for military and large commercial aircraft sales, and Mr William G. Finn marketing manager for general aviation sales, of the Avionics Division of Lear Jet Industries Inc.



Best all-round craft apprentice of the year at Hawker Siddeley's Brough factory was D. K. Dyble, and at the prizegiving held recently at Hull Guildhall he received the Director's Prize; here Mr Jack White, executive director (production) is seen congratulating him. Other awards were presented, to over 300 apprentices, by Mr L. R. Beesly, Director-General of Aircraft Production and Head of Engineering Staff, Ministry of Aviation

## TITANIUM ON THE AMERICAN SCENE

Titanium, with a heat-to-strength ratio better than that of steel and a weight closer to that of aluminium, has long interested—and plagued—aircraft and engine makers. In the early 1950s (writes an American correspondent) it was widely regarded in the US aircraft industry as the metal of the future, especially for use in the hot parts of jet engines. Since then the advance of missiles and the relative decline of bombers, coupled with the cost of titanium (it is difficult to extract and hard to form), caused many American companies to lose interest in the material.

Now, with the prospect that a US supersonic transport will go ahead in the near future, ideas are again changing. Approximately 75 per cent of the Boeing SST is specified in titanium—equivalent to about 450,000lb per aircraft.

Titanium mill production in the US during 1966 was some 25 million lb. This is a considerable increase over the 19 million lb produced in 1965; but, even so, the metal is in short supply, and the US Government is dipping into its 10,000-ton stockpile this year to the extent of 1,000 tons. However, most of the metal from the stockpile is the hard Brinell form, adequate for armour-plating in military helicopters, but less than ideal for use in jet engines or major aircraft structures without remelting and further refinement.

By 1970, say US Government estimators, home production of titanium will be up to 50 million lb, but it is likely that the metal will still be in very short supply.

Properly rolled sheet titanium for aircraft is particularly hard to find, because the technology of producing sheet in the varied thickness that will be required for SST skins (for example) remains difficult. Moreover, because the material has high resistance to corrosion, demand

for it is growing in other fields, such as those of chemical processing and water desalination.

Titanium has been finding its way more and more into the newer jet engines, and into the nacelle structures around them. The Boeing 747 will use between 40,000lb and 60,000lb; the Lockheed C-5A requires at least 30,000lb. More parts of titanium alloy are going into the commercial and military jet aircraft now coming off the assembly lines. The F-111 programme, as production rises, will take increasing amounts; and the material is increasingly being used in helicopter engine housings.

All this has the American producers of the metal—their ranks considerably thinned over the past 15 years—working overtime on expansion plans. Titanium Metals Corporation of America, the largest US producer, has begun a three-year programme to expand facilities at Toronto, Ohio, and Henderson, Nevada, at a cost of some \$50 million (£18 million). Titanium Metals is jointly owned by Allegheny Ludlum Steel Corporation and the National Lead Company.

Reactive Metals Inc, owned by US Steel Corporation and National Distillers & Chemicals Corporation, has announced a \$70 million (£25 million) expansion programme. Oregon Metallurgical Corporation is in the throes of an expansion programme to increase its titanium output severalfold over the next few years. The Aluminium Co of America, Pittsburgh Plate Glass, Bethlehem Steel, Carborundum Metal Climax, and Crucible Steel are all thinking about getting into the field and it is expected that others will follow.

Titanium prices in the US have so far held steady. Depending on thickness and length, titanium sheet prices currently run from \$4.90 (£1 15s) to \$14.00 (£5) per lb. Basic list prices for billets are

between \$2.40 (17s) and \$3.80 (£1 7s) per lb, with suppliers holding closely to their published prices.

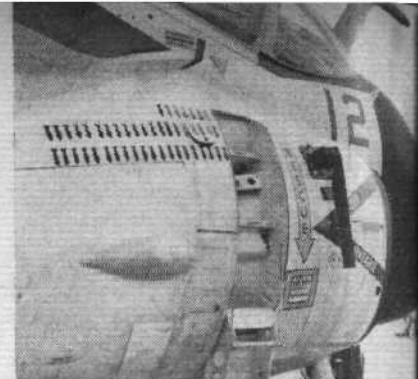
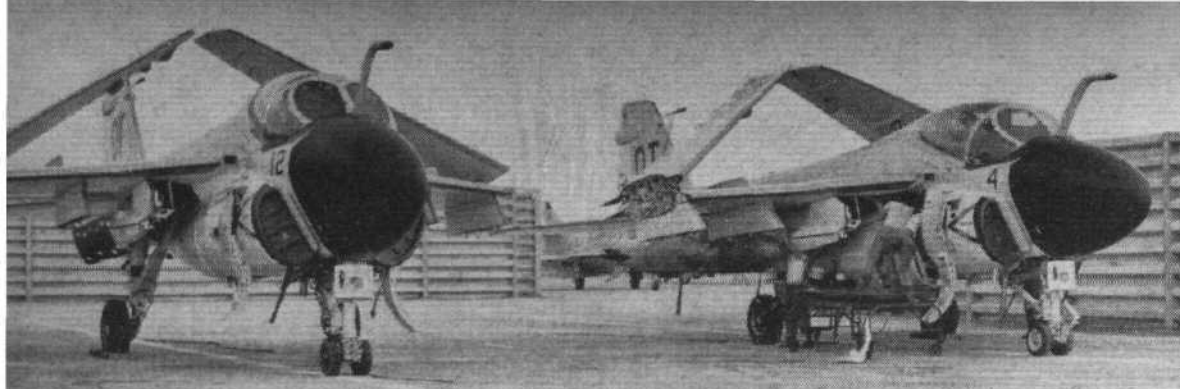
Back in 1950 the price of sheet was about \$25 (£8 19s) per lb and billets ran to \$20 (£7 3s) per lb. Then much less was known about the metal and aircraft industry interest ran very high, only to fall off rapidly. An oversupply developed and the price fell far below cost, causing several producers to leave the field—including Dow Chemical, Union Carbide, and Republic Steel.

It is likely that titanium will continue to be far more costly than the aluminium and steel alloys now used in aircraft, despite the prospect of price reductions as technology improves. Most of the titanium used in the US today comes from rutile (titanium dioxide) ore, mined principally from Australian beach sands. The long-term prospect is that titanium must be extracted from the many other titaniferous ore deposits found around the world. Quebec Iron and Titanium Corporation, owned by the Kennecott Copper Corporation and New Jersey Zinc Co, is successfully processing ilmenite ore for its iron and titanium content at Sorel, Quebec. This development is being watched with great interest in metallurgical circles all over the world.

To extract titanium from rutile ore requires the use of large amounts of chlorine, which removes the material in the form of titanium chloride. The latter is then treated with magnesium to remove the chlorine and the result is a porous material called titanium sponge, which can be melted and processed.

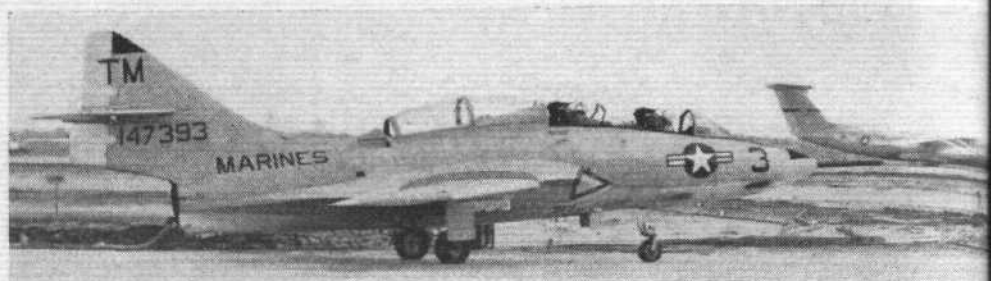
Titanium sponge produced in the US by this method costs \$1.32 (9s 6d) per lb today. Imports from Japan are landed in America at \$1.25 (9s) per lb.—but the prospect is that Japanese prices will soon match those of the US.





Newest strike aircraft in Vietnam are US Marine Corps Grumman A-6A Intruders of the 11th Marine Air Wing at Da Nang, above. Seen bombed up with 1,000-pounders is one A-6A while the one adjacent sports evidence, right, of 47 in- and out-country strikes in its first few weeks ashore. EA-6A electronic countermeasure Intruders are operated by a sister squadron from adjacent revetments. Seeing action near the end of its operational life is the Grumman TF-9J Cougar, below, also operated by the Wing on in-country reconnaissances and occasional strikes. A Lockheed C-141 StarLifter of USAF Military Airlift Command is seen beyond

"Flight" photographs



## YF-4Ks PROGRESS DESPITE "BUZZ"

THE FLIGHT PROGRAMME involving the two McDonnell YF-4K Phantoms mentioned in our previous Phantom progress report (issue of October 27, 1966) have been joined by a third, which flew for the first time towards the end of October. The first F-4K production aircraft for the Royal Navy, it will be followed by another F-4K, and two YF-4Ms, to take part in systems and weapon trials.

The first YF-4M Phantom for the RAF has been rolled out and is due to fly on February 24.

The three development aircraft at present flying have now covered a large part of the flight envelope, heights above 45,000ft and speeds up to Mach 2 having been attained. By the end of December Nos 1, 2 and 3 aircraft had logged 54, 25 and ten flights respectively, while the total flying time was about 140hr.

The first two aeroplanes are reserved for the very important engine development programme. The behaviour of the front end of the engine has been assessed over a wide range of conditions, including intake flow distortion corresponding to angles of attack at the stall, and is described as very satisfactory; no problems have arisen. But difficulties have occurred in the reheat system. At high altitudes, and at settings corresponding to 75 per cent reheat power, a rapid fluctuation of flame pattern (known as "buzz") occurs, caused by separation of the flame from the burners. This snag is attributed to incorrect fuel scheduling, and its rectification is not expected to present major difficulties.

Another area of development concerns the engine response to very rapid (half-second) throttle movement from flight

idle to full reheat, again thought to be associated with incorrect fuel management. Also, reheat light-up at altitudes over about 45,000ft is erratic. It is expected that all these problems will be solved by the time of delivery of the first aircraft to Britain in October.

No in-flight engine shutdowns have been recorded, but several engines have been prematurely removed for inspection following foreign-body ingestion.

The aircraft have been flown on a number of occasions by two British crews resident at McDonnell's St Louis factory. These crews are appointed, together with American crews, to undertake the acceptance trials which every aircraft is required to undergo before delivery to the United States Government. Such trials normally take about six hours, after which the US Government, in its turn, will transfer the aircraft to the United Kingdom. Further British crews at the USN test centre at Patuxent River will assist in this procedure.

### Naval Aviators' Options

ONE MAJOR PROBLEM arising from the Government's decision to scrap the Royal Navy's carrier force in the mid-1970s is the question of what is to happen to fixed-wing aircrew officers when they are no longer required for flying.

So that the aircrew officers may have time to think about what they want to do, details have now been announced of the various options open to them. There will be three main alternatives available;

remaining in the Royal Navy, transfer to the RAF, or release to take up civil aviation careers.

The Navy is keen to retain as many officers as possible, and will arrange where possible to re-train them for helicopter duties, or for the many other forms of duty required, such as gunnery, anti-submarine warfare, communications and so on.

For those officers who wish to continue a fixed-wing flying career in the Services, there will be opportunities for transfer to the RAF.

Finally, officers will also be eligible to be selected for release to civil airlines, and will be given the opportunity of gaining civil licences whilst still serving. To qualify for such a transfer officers must continue to serve in the Royal Navy until they are at least 37.

It is understood that when the option of transferring to the RAF, with permanent commissions, was first circulated through the Fleet Air Arm, only one naval aviator expressed interest.

### USN Order Torpedoed in Paris?

A LIKELY INTENTION of the French Government to refuse the order is now reported to be the reason why the USN is not to get the Nord AS.12 air-to-surface missiles it wants. The US Department of Defence has refused funds for this purchase (as reported in *Flight* last week) primarily, it now appears, to avoid a contretemps with France and to pre-empt a rebuff. The French Government's reported intention is to avoid allegations of "complicity" in the Vietnam war, for which the AS.12s were mainly intended.

Nord's existing missile business with the USA—mainly the Army—already totals more than \$70 million and the



AS.12 order was thought to be virtually in the bag. If the new French policy is confirmed, it may entail complications in other Franco-US agreements on military projects.

### Chinook Plant in Italy?

CONTINUING EUROPEAN INTEREST in the Boeing-Vertol CH-47 Chinook helicopter, which is one of two candidates for the RAF order for a tactical transport helicopter and which is warmly regarded by the Luftwaffe, has led Boeing to make arrangements for its production in Europe. An agreement has been concluded with the newly incorporated Italian company, Elicotteri Meridionali S.p.A., under which it receives Italian sales rights to the Chinook and, additionally, receives options on licence agreements for its manufacture and servicing.

The Italian company which, it appears, may actually have Boeing interests involved in its foundation, has a 323,000 sq ft factory at Frosinone and a wide area adjacent where future extensions are planned. It is surprising that Boeing has chosen Italy as the location of a possible Chinook produc-



The first of two HS.748 VIP transports for the RAAF is nearly ready for delivery from Woodford, as reported last week. They will be followed into RAAF service by eight navigation training versions

tion line, for the potential requirements of other European countries are both larger and more pressing.

### A-7 Corsair Developments

REPORTED FROM WASHINGTON are DoD studies under which the feasibility of reducing the number of F-111As ordered for the USAF in favour of late-model F-4 Phantoms and A-7 Corsair IIs is being investigated.

The first production Corsair for the USAF will be the A-7D version which, in addition to its Allison-built Rolls-Royce TF-41 Spey engine, will have

very different electronics to distinguish it from the USN's early A-7A and A-7B models. The avionics will include a new head-up display unit, a new weapons computer with both true dive and toss dive modes, a stabilised gunsight aligning with the aircraft track rather than the centreline, an inertial navigation system, provision for a laser range-finder, ECM equipment and USAF-type bomb-racks.

The USN is reported to be planning two two-seat Corsair versions, designated A-7C and A-7E, but these are not yet subjects of contract.

## "FLIGHT" AND Mr DIVINE

The following statement was made by the Press Council on January 25:—

An allegation that the Air Department of the Ministry of Defence used "clandestine methods to attack a private individual" was part of a complaint made to the Press Council as an outcome of publication in the magazine *Flight International* of paragraphs critical of a book *The Broken Wing*, by David Divine.

A contribution by a named writer praised the book but the critical paragraphs were anonymous. They were introduced by the statement: "*Flight* makes an exception to its 'no anonymity' rule to publish the following further comments. They are by reviewers who for professional reasons have to remain anonymous.—Ed." [*Flight*, June 23, 1966.]

The first group of four paragraphs was attributed to "Beam-riders" and ten following paragraphs were by "Tracker." All consisted of material issued by the Air Department of the Ministry of Defence. In the material issued to the journal the paragraphs by "Beam-riders" were stated to be comments by the Air Historical Branch. The remaining comments were headed on the copy "Comment by the Air Staff."

Mr David Divine, 24 Keats Grove, London NW3, lodged a twofold complaint with the Press Council. He claimed that the Editor of *Flight* falsified the origin of the material, and completely misrepresented its basic character. Mr Divine also complained that the Editor had refused to publish a rebutting letter.

Mr Divine further submitted that, while a Government department had every right to defend itself against attack, the method adopted in this instance was objectionable in the highest degree as it refused to acknowledge its authorship of the attack on a private individual.

There seemed to have been, said Mr Divine, "a blatant attempt to interfere with the primary right of reviewers to exercise independent judgment" and he considered

the action of the Air Department to be a deliberate attempt at the surreptitious "management of views."

In a letter to the Editor of the magazine, which he asked should be published, Mr Divine said that the material prepared by the Public Relations Division of the Air Department of the Ministry of Defence under the direction of its Director of Public Relations, Air Commodore J. Wallace, was circulated to a selected list of Air Correspondents and Defence Correspondents and withheld from others. It was made clear that the identity—and the responsibility—of the Air Department and the Royal Air Force was not to be admitted. The material was rejected wholly by all its recipients except the Editor of *Flight International*.

Mr J. M. Ramsden, Editor, *Flight International*, told Mr Divine that the handout arrived from the Ministry of Defence (Air) with no indication that it was not for attribution. When he was passing the pages he rang the Ministry to make sure that it was for attribution. In the absence of Air Commodore Wallace an agitated official said that it most certainly had not been intended for attribution.

There was no time to replace the matter with something else, and the only course open was to make it anonymous. He could not have published Mr Divine's letter without betraying a source. It was absurd to suggest that the official view of Mr Divine's book was presented as an independent review. None of the magazine's readers could have doubted that "Beam-riders" and "Tracker" were RAF men.

Air Commodore J. Wallace, Director of Public Relations (RAF), Ministry of Defence, informed the Press Council that in view of the theme of the book it was deemed necessary to send out the comments to assist individuals, including possible reviewers, to assess the validity of the author's theme and to redress the balance of "a thoroughly biased account of the development of military aviation in this country." He imagined

nobody would question the right of the Service to defend itself fairly against a book of that kind. It would be a naïve reader indeed who would not immediately have been aware of the origin of the comments.

In oral evidence Air Commodore Wallace said that on reflection he did not see why the original statement should not have gone out as a Ministry of Defence statement. He thought the Department was perfectly justified in sending out its views "as such." Guides offered to the Press by the Department were always on a non-attributable basis.

Mr Ramsden said in oral evidence that when he was told by Air Commodore Wallace's office that the document was not to be attributed he was dismayed. It was his idea to use the pseudonyms of reviewers.

Mr Divine, also giving oral evidence, said there was no doubt that the writers of the material were RAF men. But there was the question whether they were RAF officers writing as independent reviewers or under direction from the Air Board or the Press Division. That was an entirely different matter. If the comments had been attributed to the Air Historical Branch, he would not have complained. It was perfectly fair that a Government department should defend itself.

The Press Council's adjudication, issued today [January 25], was:

The Editor of *Flight International* was entitled to publish opinions on the book *The Broken Wing*, additional to those of his regular reviewers, but in the circumstances it was unethical not to attribute them to their sources. This complaint is upheld.

The Council does not agree that the distribution of the Air Staff criticisms was an attempt by a Government department at surreptitious management of views and this complaint is rejected.



# US BUDGET FOR DEFENCE AND SPACE

**R**ECOMMENDATIONS for US Government spending on defence and space projects were included in President Johnson's budget message to Congress on January 24. This article is based on extracts from this message and from his State of the Union message on January 10. The proposed budget is subject to the approval of Congress.

In his State of the Union message President Johnson said:—  
"The Soviet Union has in the past year increased its long-range missile capabilities. It has begun to place near Moscow a limited anti-missile defence. My first responsibility to our people is to assure that no nation can ever find it rational to launch a nuclear attack or to use its nuclear power as a credible threat against us or our allies.

"That is why an important link between the Soviet Union and the United States is our common interest in arms control and disarmament. We have the duty to slow down the arms race between us, in both conventional and nuclear weapons and defences. Any additional race would impose on our peoples, and on all mankind, an additional waste of resources with no gain in security to either side."

The estimated total defence spending recommended by the President for the 1968 fiscal year (beginning July 1, 1967) is \$75,000 million, of which the Poseidon missile accounts for \$1,115 million. The Minuteman missile programme would take \$20 million, and the Nike-X anti-missile development would account for \$375 million. US defence officials have estimated that \$4,000-\$5,000 million would be needed to set up an anti-ballistic-missile system to protect US strategic missile sites only.

## Budget Proposals

The proposed budget is based on US strategic forces which would include over 1,050 land-based and 512 submarine-deployed missiles and 600 strategic bombers. Defensive forces would include 30 interceptor aircraft squadrons, six Bomarc interceptor missile squadrons and 18 air defence missile battalions. In his budget message President Johnson said:—

"Today, our military requirements are dictated by two fundamental realities. We must continue to counter aggression in South Vietnam. We must also continue to enhance our ability to meet changing threats to our freedom and security elsewhere. The 1968 budget will ensure that our forces remain equal to both these tasks.

"Though small in relation to the nation's total economic activity, the cost of honouring our commitment to South Vietnam is nevertheless substantial. Expenditures necessary to support military operations in South-East Asia will total \$21,900 million in 1968, about three-tenths of budget expenditures for national defence. A year ago we were in the midst of a rapid build-up of our forces in Vietnam. Rather than submit a budget to the Congress based on highly uncertain estimates, I requested funds sufficient to finance the conflict through fiscal year 1967. At the present time the situation is different. While unforeseen events can upset the most careful estimate, we are in a much better position to determine our future requirements in Vietnam. As a consequence, my 1968 budget provides for those requirements on a continuing basis, including the possibility of an extension of combat beyond the end of the fiscal year. In 1968, we will:—

"Continue intensive development of Nike-X but take no action now to deploy an anti-ballistic missile (ABM) defence; initiate discussions with the Soviet Union on the limitation of ABM deployment; in the event these discussions prove unsuccessful, we will reconsider our deployment decision. To provide for actions that may be required at that time, approximately \$375 million has been included in the 1968 budget for the production of Nike-X for such purposes as defence of our offensive weapon systems.

"Maintain our decisive strategic superiority by initiating procurement of the advanced Poseidon submarine-launched missile, improving our present strategic missiles, and further safeguarding our capacity to direct our forces in the event of attack.

"Provide our forces in Vietnam with all the weapons and supplies they need and add to our war reserves at the same time.

"Add to the mobility and effectiveness of our general-purpose forces by increasing the fire power of our ground forces, enlarging our helicopter strength, pursuing a vigorous shipbuilding and conversion programme, and purchasing additional modern tactical aircraft.

"Increase our airlift and sea-lift capabilities by further procurement of the giant C-5A transport plane, and procurement of five fast-deployment logistics ships.

"Continue the vigorous research and development programmes vital to maintain the most modern, versatile, and potent forces in the world."

## Space Expenditure

The estimated expenditure for the National Aeronautics and Space Administration amounts to \$5,300 million compared with \$5,600 million in the current fiscal year. The President asked Congress to appropriate \$5,050 million in "new money" for NASA, compared with \$4,968 million for 1967. A total of \$454.7 million is earmarked for the start of the Apollo applications programme, to be carried out in the 1970s at an ultimate cost of about \$2,500 million.

In NASA's unmanned space science programme \$71 million is requested for development of the Voyager spacecraft, which would land on Mars in 1973.

A decision to build a nuclear rocket engine for flight use would eventually cost about \$2,500 million; such a rocket would be used as an upper stage for the Saturn 5 vehicle. According to NASA officials, a decision later this year to go ahead with the nuclear rocket could result in a first flight test by 1977 and an operational rocket in 1980.

In the defence budget a figure of \$430 million is allocated to the Manned Orbiting Laboratory (MOL) programme.

In his budget message the President said:—

"In 1961, this nation resolved to send a manned expedition to the Moon in this decade. Much hard work remains and many obstacles must still be overcome before that goal is met. Yet, in the last few years we have progressed far enough that we must now look beyond our original objective and set our course for the more distant future. Indeed, we have no alternative unless we wish to abandon the manned space capability we have created.

"This budget provides for the initiation of an effective follow-on to the manned lunar landing. We will explore the Moon. We will learn to live in space for months at a time. Our astronauts will conduct scientific and engineering experiments in space to enhance man's mastery of that environment.

"The Surveyor and Orbiter projects, in photographing the Moon, have demonstrated dramatically the value of unmanned spacecraft in investigating other objects in the solar system. Accordingly, we are proceeding with the development of the Voyager system for an unmanned landing on Mars in 1973. We will also continue other unmanned investigations nearer the Earth.

"In recent years the National Aeronautics and Space Administration and the Atomic Energy Commission have jointly undertaken the development of nuclear rocket propulsion technology. We are now considering whether that effort should be expanded to the development of the rocket itself. The overall budget totals allow for the possibility of proceeding if an affirmative decision is reached.

"These new ventures are the result of careful planning and selectivity. We are not doing everything in space that we are technologically capable of doing. Rather, we are choosing those projects that give us the greatest return on our investment.

"To support these new projects and to maintain our existing programmes, an increase of \$82 million is requested in new obligational authority for the National Aeronautics and Space Administration for 1968. Expenditures, however, will decline by \$300 million in the coming year, primarily because of reduced requirements for the manned lunar landing programme."





Preparing for Apollo: (left to right) NASA astronauts Roger Chaffee, Edward White and Virgil Grissom at work in the Apollo spacecraft simulator at Cape Kennedy. As reported on this page, the three men were killed when their spacecraft caught fire during a practice countdown on January 27

## Spaceflight

### THE APOLLO 1 DISASTER

Lt Col Virgil Grissom, Lt Col Edward White and Cdr Roger Chaffee, the crew chosen to make the first manned flight in NASA's Apollo programme, were killed in a launch-pad accident at Cape Kennedy on January 27. A practice countdown in preparation for the Apollo 1 flight (scheduled for February 21) had progressed to "T minus 10min and holding" when, in the words of Maj Gen Samuel Phillips, director of the Apollo programme, "A flash fire originated inside the capsule and surrounded it for a matter of split-seconds."

The hold in the countdown was reportedly caused by poor-quality communications between the spacecraft and the control centre. Gen Phillips said that one of the astronauts had reported "Fire in the spacecraft" by radio just before the accident. Technicians on the servicing tower attempted to extinguish the fire immediately, and succeeded in opening the hatch of the spacecraft 5min later. The astronauts were found still strapped in their seats.

The spacecraft was using its own electrical power at the time, Gen Phillips said, but the problem had not developed when the crew switched from ground power to the onboard power system. A board of inquiry was set up on January 28 to investigate the cause of the accident.

Even if no design fault in the spacecraft were found, the general indicated, the first manned Apollo flight could not now take place until May or June at the earliest. There was no spare flight spacecraft at the Cape; to prepare and transport

one there from the maker's plant, North American Aviation at Downey, would take about six weeks and to check it out after arrival would take another six weeks.

Whatever the source of the ignition, the speed with which the fire spread—the "flash" effect described by Gen Phillips—must be attributed to the 100 per cent oxygen atmosphere inside the spacecraft. The Apollo spacecraft is not equipped with ejection seats—in any case the Apollo 1 craft was within the servicing tower at the time of the accident—and it would have taken the astronauts several minutes to open the hatch from the inside and climb out.

(Biographies of the astronauts, page 183.)

### WORLD SPACE ASSEMBLY: FIRST DETAILS

Almost one thousand delegates from 130 countries are expected to attend the United Nations conference on the exploration and peaceful uses of outer space, to be held in Vienna during September 11-23. Invitations to States and organisations have been issued by the UN Secretary-General, and planning for the conference is well under way.

The two main aims of the conference are (a) to examine the practical benefits to be derived from space research and exploration on the basis of technical and scientific achievements; and the extent to which non-space powers, especially the developing countries, may enjoy these benefits; and (b) to examine the opportunities available to non-space powers for international co-operation in space activities, taking into account the extent to which the UN may play a role.

These aims are to be achieved by the delivery and discussion of a number of papers, which will cover *inter alia* the following topics:—

(1) General appraisal of achieved and possible contributions by scientific and technical research in outer space and by international co-operation in providing practical benefits, especially for developing countries, in the field of biology, medicine, communications, meteorology and navigation and in other fields;

(2) Implications of space exploration for education, with special reference to possibilities of establishing programmes for the education and training of specialists to assist the developing countries in the peaceful uses of outer space; and

(3) Various other implications of expanding space exploration and research.

An introductory session at the conference will review the results of space research during the ten years of the space age. These will include basic scientific results in the physical exploration of the upper atmosphere and outer space, manned spaceflight, lunar and planetary research, with particular emphasis on their practical meaning.

This will be followed by nine thematic sessions devoted to communications; meteorology; navigation; other space techniques of practical benefit; biology and medicine; non-space applications of space technology; education and training; international co-operation and opportunities for participation in space research and application; and economic, legal and social problems of exploration and use of outer space relevant to international co-operation and practical benefits.

### OAQ DEFECTS TRACED

A detailed review of NASA's observatory-class spacecraft, and in particular of the failure of the first Orbiting Astronomical Observatory satellite in April 1966, was completed recently by the NASA review board set up by Dr Homer E. Newell, Associate Administrator for Space Science and chaired by Mr Robert F. Garbarini.

The in-flight failure of OAO-1 was described by the board as follows:

"At 1935:00.490 GMT on April 8, 1966 the OAO-1 was launched from the Eastern Test Range into a nominal 500-mile circular orbit inclined 35° to the equator. For seven minutes after separation from the Agena, available data indicated that the spacecraft performance was according to plan and satisfactory. At about eight minutes after separation, it is believed that an electrical transient produced an adverse effect on some of the equipment. For example, one of the star trackers experienced an unscheduled turn-on and roll search was terminated. Subsequent to this incident, data indicate that all



## Spaceflight

equipment resumed normal operation except for a loss of a row (20 channels) of spacecraft status data.

"Contact with the observatory from the Rosman ground station during the first orbit indicated that several other anomalies had occurred subsequent to the Australia contact: the spacecraft clock had been reset unexpectedly; the spacecraft was in roll-search; two more rows of status data had been lost and the temperature of the battery being used had risen slightly.

"Such anomalies persisted throughout the short life of the spacecraft. The periodic unintentional resetting of the spacecraft clock, about every other orbit, prevented effective programmed control of the spacecraft when it had passed out of real time control. The loss of status data channels further handicapped spacecraft analysis.

"In order to reduce the battery temperature, the spacecraft was placed into a temporary tumble mode in orbit No 17 in order to induce battery cooling through reduced charging. However, this resulted in battery depletion and after orbit No 20, on April 10, 1966 no further communications were received. The experiments were never activated. . . ."

The probable "direct and immediate cause" of the OAO-1 failure was traced to a failure in the battery charge and sequence controller, which appeared to have caused overcharging of a battery pack and the power system. It was further believed that the major disruption of the operation of the spacecraft was caused by arcing in the star-trackers. Although it could not be proved conclusively that star-tracker arcing did occur in orbit, ground tests showed that many of the observed operating anomalies could be duplicated when the star-trackers were caused to arc.

It was not possible to determine whether failure of the battery charge and sequence controller was associated directly with star-tracker arcing, because telemetry during launch was not available and half of the in-flight spacecraft analogue data was lost—apparently because of the arcing.

Other weaknesses in the spacecraft system were identified which could have contributed towards the OAO failure. These included "noise susceptibility of the stabilisation and control subsystem and the communication and data-handling subsystem that resulted in initiation of restabilisation, jet firing, star-tracker mode switching, error bursting, and loss of data channels, tracking of false stars by the star-trackers; operation problems with the unloading of the momentum wheels and execution of stored commands; and possible thermal problems in the battery compartment."

The review board recommended that the OAO spacecraft subsystems should be modified to include the following improvements:—

(1) Provisions for the reliable charging and control of the batteries including redundancy (parallel operation); a power system not dependent on spacecraft manoeuvring to achieve a negative energy balance (deep discharge of batteries); and separate spacecraft-ground complex battery connections for battery conditioning.

(2) Elimination of arcing, error bursting, and false star-tracking, suppression of noise generation; and reduction of noise sensitivity in all equipments.

(3) Provision for stabilisation and control with the ability to hold the attitude of the spacecraft by an inertial system (such as an improved version of the rate and position system currently planned for the next mission) during star occultation and other desired holding modes; circuit logic to permit a reliable determination of when the control system can switch to the fine pointing mode; and means for unloading the fine momentum wheels when not in fine pointing.

(4) Provisions for spacecraft status telemetry from count-down, through launch and orbital phases; adequate telemetry with proper time identification encoded into the data.

(5) Changes in interfaces to protect the equipment from electromagnetic interference and other potential sources of failure.

In addition to these design changes required by technical aspects of the OAO-1 failure, the board recommend a number

of other improvements. These were based on a general updating in the fields of mission analysis, system and subsystems analysis, systems testing, flight operations and project support. In particular the board recommended that the testing programme should be extended to simulate more fully the expected space environment, and should readopt the use of a prototype model for each of the OAO missions. The OAO project organisation at Goddard Space Flight Centre should be strengthened.

In addition to the *ad hoc* investigation of the OAO-1 failure, the review board completed a general investigation of project practices in all NASA's observatory-class spacecraft—the Orbiting Geophysical Observatory and Orbiting Solar Observatory series as well as the OAO satellites. All these programmes were handled by Goddard Space Flight Centre, whose record since 1959 comprised a total of 50 spacecraft successfully injected into orbit. Of these, 42 were non-observatory types (41 of which were successful), while the observatory spacecraft had comprised five successes and three failures. The successes were OSO-1, OSO-2, Nimbus 1, Nimbus 2 and OGO-3, and the failures were OGO-1, OSO-2 and OAO-1.

The board commented that the observatory-class spacecraft were generally larger and more complex than Goddard's other satellites; their development contracts had been initiated between September 1959 and June 1961; the record of observatory spacecraft performance had been achieved without the benefit of engineering test flights; and OGO-1 and 2, recorded as failures because they did not achieve stabilisation, had in fact accomplished more than half of their scientific objectives in a spinning mode—and had collected more scientific data than all other Goddard geophysical satellites combined.

As in the OAO-1 investigation, the board concluded that many improvements were needed stemming from the early date at which the various observatory satellites had been conceived. They did not reflect the current state of the art in a number of areas. The board recommended a number of specific improvements in management, design, reliability and quality assurance methods, test procedures and spaceflight operations and direction at the Goddard centre.

### LUNA 12 COMPLETES PROGRAMME

The Soviet news agency Tass reported on January 21 that Luna 12, the third Soviet lunar satellite, had successfully completed its flight programme. It was placed in orbit around the Moon on October 25. The Tass report continued:—

"When the station was in its 602nd orbit of the Moon on January 19, radio communication with the station was ended. Luna 12 has covered 9,800,000km around the Moon, and 302 radio-communication sessions were held with it. During its three-month flight Luna 12 carried out a great amount of scientific research and transmitted back to Earth pictures of the lunar surface.

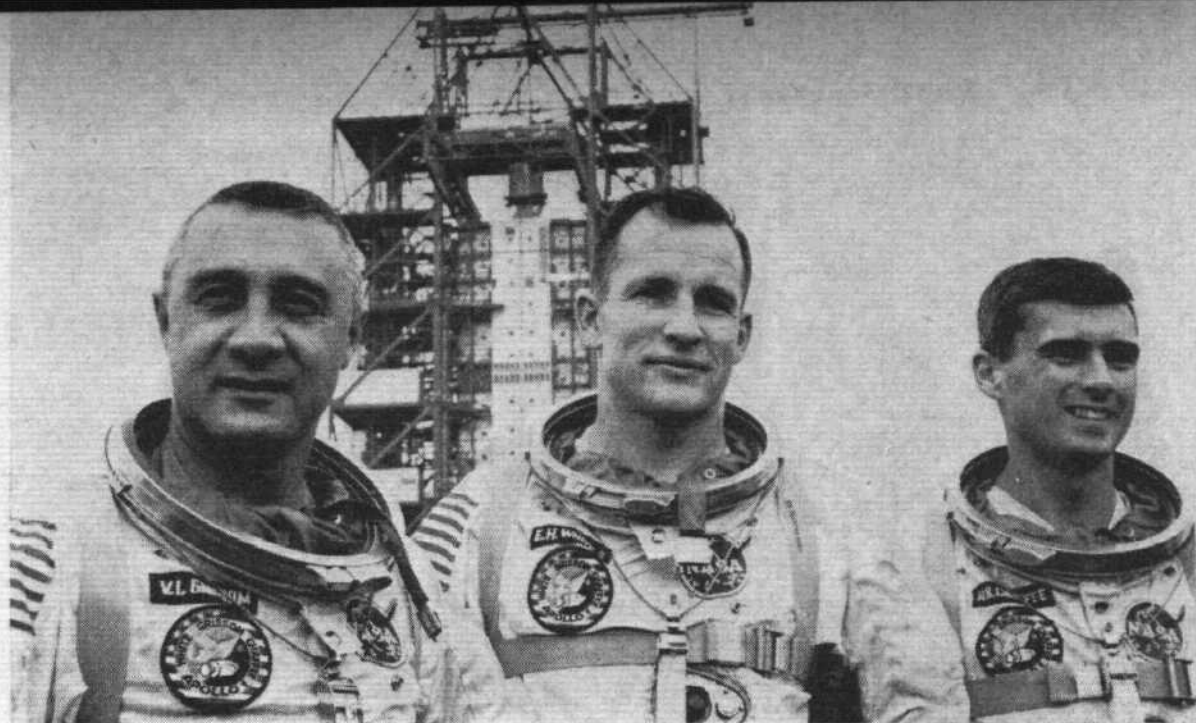
"Detailed measurements of the gamma radiation by the lunar surface, X-ray fluorescent radiation, corpuscular radiation and the density of the micro-meteoritic matter near the Moon were carried out. Radio-astronomical observations in the long-wave range, begun by Luna 11, were continued."

**Explorer 1 Still There** Explorer 1, the first satellite launched into orbit by the USA (on January 31, 1958), is still in orbit after nine years. Present orbit is at 210-890 miles, and the expected date of decay is late 1969.

**Diamant Satellites** Two more French scientific satellites, designated D-1C and D-1D, are scheduled to be launched by the third and fourth Diamant vehicles from Hammaguir during this month. These will be the last satellite launchings from the Sahara site.

**Cosmos 139** was launched into Earth orbit at 144-210km, 50° inclination, on January 25, but apparently was recovered from orbit within 24 hours. The satellite apparently was launched from the site near Archangel and may be associated with the recent unannounced spacecraft known as Cosmos U-1 and U-2, both of which exploded or separated into a large number of pieces.





## THE APOLLO 1 FLIGHT CREW

*The death of astronauts Grissom, White and Chaffee in the accident at Cape Kennedy on January 27 (reported on page 181) is a severe blow to NASA's Apollo programme. Brief biographies of the three men follow.*

**Virgil I. Grissom, Command Pilot** Born in Mitchell, Indiana, April 3, 1926; selected as Mercury astronaut in April 1959; pilot of *Liberty Bell 7* on Mercury-Redstone 4 sub-orbital flight on July 21, 1961; command pilot of Gemini 3 orbital flight on March 23, 1965. Married, with two sons.

Entered USAF as aviation cadet in 1944, discharged Novem-

ber 1945. Graduated Purdue University with degree in mechanical engineering in 1950, returned to aviation cadet training after graduation. Received wings March 1951.

Joined 75th Fighter-Interceptor Squadron at Presque Island, Maine, as F-86 pilot. Flew 100 combat missions in Korea in F-86s with 334th Fighter-Interceptor Squadron. Left Korea in June 1952 and became jet pilot instructor at Bryan, Texas. Entered USAF Institute of Technology at Wright-Patterson AFB, Ohio, to study aeronautical engineering. Attended Test Pilot School at Edwards AFB in October 1956 and returned to Wright-Patterson AFB in May 1957 as test pilot, Fighter Branch.

Flying hours total over 4,000, including over 3,000 in jet aircraft. Awarded the Distinguished Flying Cross and the Air Medal with Cluster for service in Korea.

**Edward H. White, Senior Pilot** Born in San Antonio, Texas, November 14, 1930; selected as NASA astronaut in September 1962; pilot of Gemini 4 orbital flight on June 3, 1965; first US astronaut to go outside spacecraft during orbital flight. Married, with one son and one daughter.

Received Air Force flying training in Florida and Texas following graduation from West Point. Spent 3½ years flying F-86s and F-100s with a fighter squadron based in Germany. Attended Air Force Test Pilot School at Edwards AFB in 1959.

Later assigned to Wright-Patterson AFB, Ohio, as an experimental test pilot with the Aeronautical Systems Division. During this period he completed flight tests for research and weapon system development and made recommendations for improvement in aircraft design and construction.

Flying hours total over 3,600, including more than 2,200 in jet aircraft.

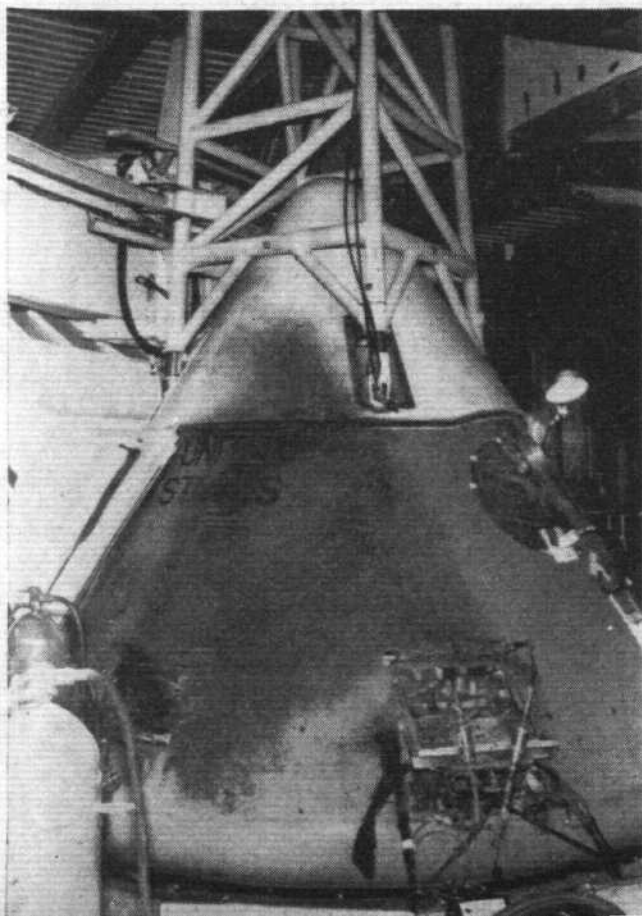
**Roger B. Chaffee, Pilot** Born in Grand Rapids, Michigan, February 15, 1935; selected as NASA astronaut in October 1963. Married, with one son and one daughter.

Graduated Purdue University with degree in aeronautical engineering prior to entering US Navy in August 1957. Served as a pilot and as safety and quality control officer for Heavy Photographic Squadron 62 at Jacksonville, NAS, Florida.

Entered Air Force Institute of Technology at Wright-Patterson AFB, Ohio, in January 1963 to work for Master of Science degree in reliability engineering. Responsible in Apollo programme for communications and Deep Space Network, and had specific area of responsibility in spacecraft attitude and translation control systems.

Flying hours total more than 1,900, including approximately 1,600hr in jet aircraft.

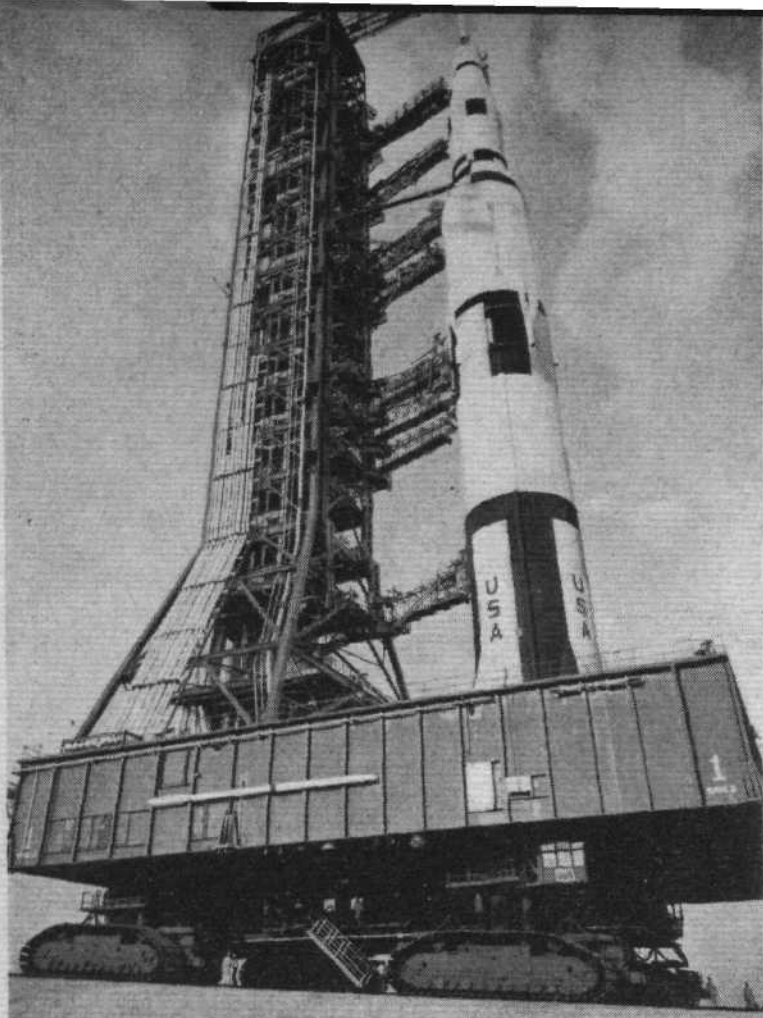
*Heading picture: left to right, Virgil Grissom, Edward White and Roger Chaffee. Below, the Apollo 1 spacecraft after the January 27 fire in which the three astronauts were killed*





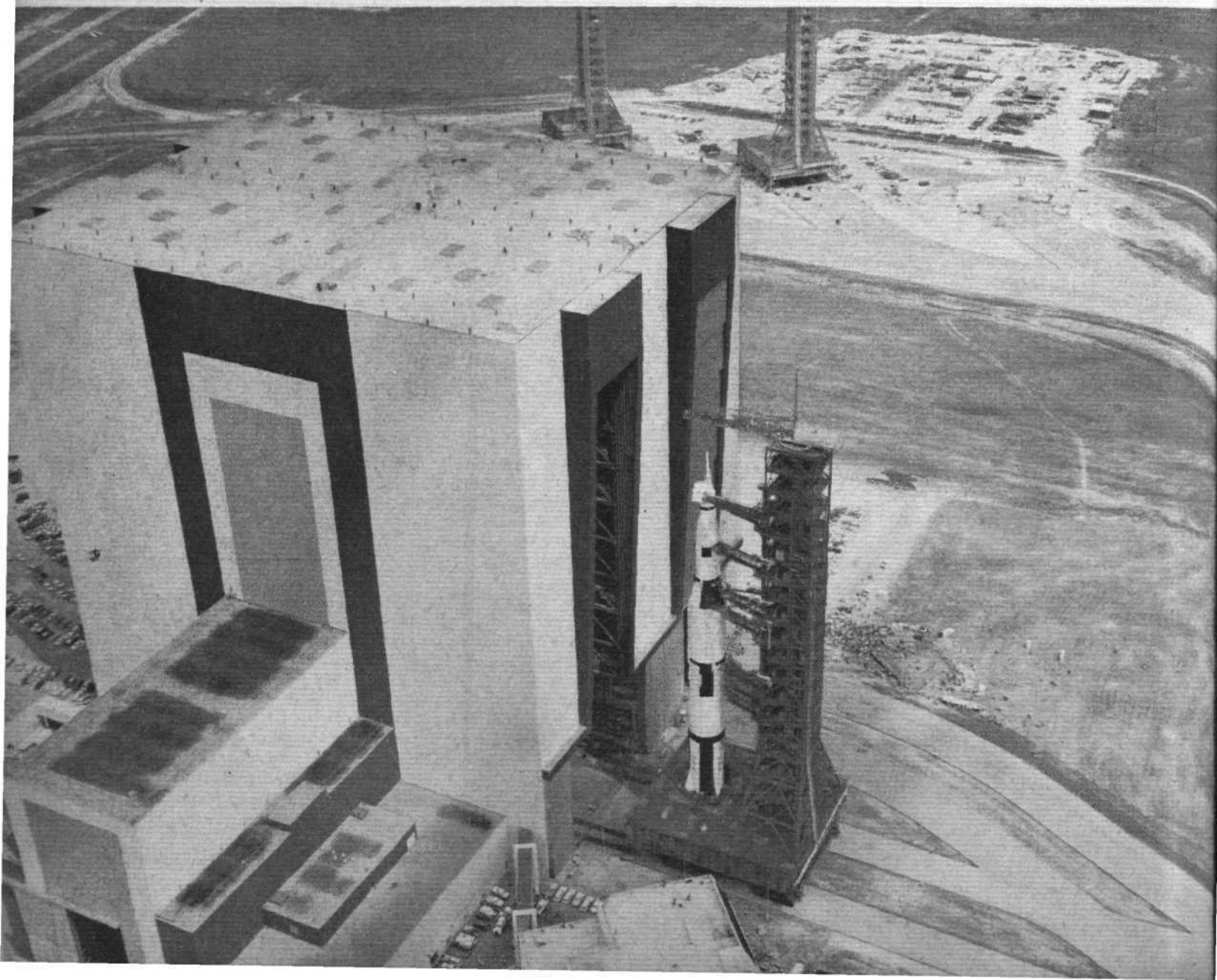
## **Spaceflight**

### **CHECKING-OUT SATURN V**



"Not so much a building to house a Moon vehicle as a machine to build a Moon craft"—this comment on the Vehicle Assembly Building at Launch Complex 39 on Merritt Island, Cape Kennedy, was made by the leader of the team of architects and engineers who designed it. A dramatic impression of the scale of the facilities at Complex 39 is given in these photographs, which focus attention in turn on the Saturn V vehicle (right), the vehicle assembly building (below) and the crawler transporter (left) which carries the Saturn and its mobile launcher from the VAB to the launch pad.

The vehicle assembly building consists of a high-bay area 525ft 10in tall  $\times$  442ft long  $\times$  518ft wide, and a low-bay area 210ft 4in tall, 272ft 6in long  $\times$  442ft wide. The Apollo/Saturn V vehicle is 365ft high; on its journey from the VAB to the pad the transporter makes 1 m.p.h. down the straight crawlerway, slowing to 0.8 m.p.h. around the bend and 0.3 m.p.h. up the ramp to the pad. The facilities of Complex 39 were checked-out recently using the Apollo/Saturn V-500F facility vehicle shown in these photographs.











## Straight and Level



**T**HE AIRCRAFT INDUSTRY is one of the great growth industries of our day," declares the Minister of Technology, Mr Anthony Wedgwood Benn.

Ever since Mr Aubrey Jones's day, right up to Plowden and (if you will pardon the word) his report, the aircraft industry was going to have to contract from 250,000 to about 150,000 employees, it was said. So—good for Big Benn.

He adds that aviation will "strengthen Mintech's hand." Mintech? Mintech? I gather that this is the official new trendy abbreviation for Ministry of Technology.

I hope that Mintech doesn't turn out to be the Mintech with the hole in it. Or the Mintech with humbug flavouring.

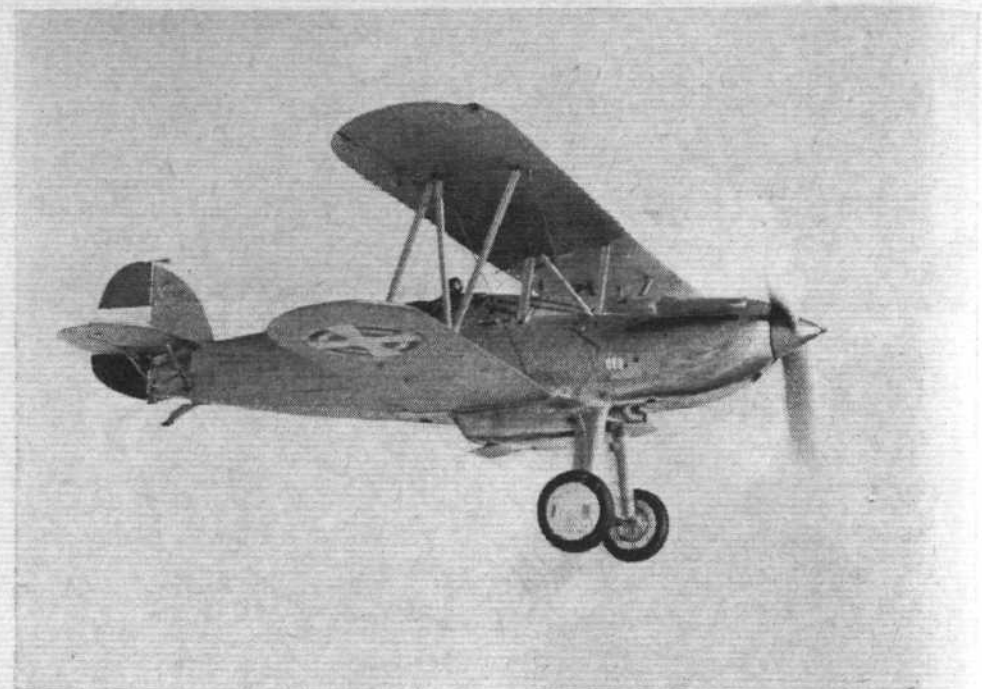
● In a two-page foreword to *New Technology*, the Ministry's new publication, Mr Benn refers several times to the aircraft industry or to the aviation industry.

May I say how really very grateful I am to him—not for mentioning the subject, but for not using that GHAUSTLY word aerospace.

I hope he bans its use for ever, and asks the SBAC to revert to its original and so much nobler name.

● "The struggle between the two manufacturers [to re-equip BEA] is intense, and both have recently submitted revised details of their designs to the airline, with better seat-mile costs"—from the *Financial Times*, January 14.

This struggle to please the customer will result in the best possible British aircraft for BEA. Everyone in BEA



**Thirty years have flown—No 6** A Hawker Fury, my favourite fighter of the thirties, for the Yugoslav Air Force. This "Flight" photograph first appeared in our issue of February 4, 1937

knows this. Everyone in HSA and everyone in BAC knows this. And I feel sure that Mr John Stonehouse, the Government's BAC/HSA merger hatchet-man, knows it too.

So why the merger? Why destroy for ever the thing that gets the most out of men—competition? Why, why, why?

What disturbs me is not so much that nobody is answering this question, but that nobody is even asking it.

● "A German air force transport plane landed by mistake at disused Hendon airfield yesterday. It should have landed at nearby Northolt"—from the *Sun*, January 26, 1967.

Another "last flight out of Hendon"? So many pilots seem to mistake it for Northolt that we might save everyone an awful lot of trouble if it were officially reopened. Then everyone would land at Northolt—especially if they closed it, eh Hoskins?

This certificate has been going around CDI — Comprehensive Designers International, the American design colony in Southall, where British aircraft designers work on the Lockheed C-5A. Southall is in England, isn't it?

Discussions between Mr. Tim Fortescue, joint secretary of the Conservative Aviation Committee broke off after two years today with only half the items on the agenda having been discussed.

From a report about Liverpool Airport in the "Northern Despatch," January 6, 1967

● Distinguished anthropologist Dr Nut, excavating the site of the old Ministry of Planes, has uncovered prehistoric in-tray fragments and fossilised CONFIDENTIAL blocks that throw new light on the origins of Civil Service Man.

"It is probable," says Dr Nut, "that Civil Service Man was engaged on some sort of European Airbus Committee 20,000,000 years ago."

Dr Nut confirms that Civil Service Man had a shiny trouser-seat and huddled together in committees for protection. His brain-pan was too small for taking decisions and he was dominated by Treasury Man—a higher form of being with massive intellects and knight-hoods. Civil Service Man survived for so long, Dr Nut believes, because he developed an ingenious defence mechanism known as Security.

● I see that the RAAF will accept only non-smokers for training on the F-111. An RAAF doctor maintains that smoking is the number one enemy of supersonic and space-vehicle crews.

I've been off them for a long time now. F-111s I mean.

ROGER BACON

**Voluntary Enlistment**

**PLEDGE**



I voluntarily pledge to continue to strive toward perfection in my work and will be ever conscious that I am an important member of the Lockheed/CDI Ltd. team whose battle cry is 'Guaranteed Perfect by UK CDIL'.

Signed \_\_\_\_\_

**PURPOSE**

To give all of our customers the utmost in value.

To instill in each of us the determination to do every job right the first time -- preventing errors instead of correcting them.

