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RAF's new jet trainer

The RAF is soon to choose its new jet trainer. Before mid-summer, if all goes to plan, an order will be placed for one of three: the Dassault Dornier Alpha Jet; the Hawker Siddeley HS.1182; or the BAC project. Though the Alpha Jet is considered to be an aircraft of excellent promise the Royal Air Force, more anxious than ever to play its part in retaining the strength of Britain's aircraft industry, will probably choose one of the rival British products.

Whichever is chosen industry and customer are determined to make a really good aeroplane quickly and on cost. Although the aerodynamics will not extend designers beyond the 1950 era, the art of structural design, propulsion and control systems can still be greatly advanced in an aircraft of this class. It is not just a question of doing again in 1971 what Folland and Hunting did nearly 20 years ago.

The RAF's requirement is for a "mid-stream" trainer—something between the Jet Provost and the two-seat combat types. It is the result of a most detailed RAF review of its training requirements over the next ten years. The Jaguar, which began life in 1964 as just such a trainer, is now regarded as too expensive for this role. In any case, the RAF—

following the F-111 fiasco—finds itself seriously short of strike aircraft. The Jaguar is now regarded by both the RAF and l'Armée de l'Air as a strike aircraft, a "mini" Phantom without the air-defence capability but with a remarkable field performance. This is why both air forces are now specifying a "cheap and cheerful" jet trainer.

The lesson of the Jaguar needs to be noted. Already the RAF is talking about the need for twin engines (either Adours or Viper 600s) and about a combat version for ground-attack work. The temptation to enhance capability by a small improvement here and small addition there may be greater still when the Ministry of Defence is supplying as well as buying. The industry too, more anxious than ever to please its prime customer, might easily be tempted to complicate and price the project out of the market.

If these temptations can be resisted, and if this relatively simple project is not crushed beneath the weight of too many ministry committees, it could meet a target price of £400,000 and still be selling 20 years hence, training as yet unborn young men for posting to squadrons of that most important of all defence programmes, the Anglo-German-Italian MRCA.

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Front cover: Concorde heralds the dawn of commercial supersonic travel which will become the accepted norm of the decades to come. In this issue we present the first instalment of a detailed three-part analysis of the aircraft and its prospects



WORLD NEWS

UK defence procurement reorganised

From April 1 next year the whole of British defence equipment procurement will come under a single agency in the Ministry of Defence, to be known as the Procurement Executive. This is the chief recommendation in a White Paper published by the Government on April 7.* Among its other main recommendations are that responsibility for policy towards the aerospace industry, and towards civil aerospace research and development and projects, will be transferred to the Minister for Trade and Industry. The Ministry of Aviation Supply, set up last year to take over the aerospace functions of the former Ministry of Technology, will cease to exist on May 1. Another main recommendation is for a Ministerial Aerospace Board, main members of which are the Minister of Defence and of Trade and Industry, to deal with procurement policy problems.

These recommendations, which have been accepted by the Government, are based on a report prepared by a seven-man project team led by Mr D. G. Rayner, a director of Marks and Spencer. This report forms a major part (41 pages) of the 58-page White Paper. Mr Rayner himself has been appointed Chief Executive of the new Procurement Executive, initially as Chief Executive-designate from October 1 this year, then starting a two-year term on April 1, 1972. Other senior appointments to the PE will shortly be announced.

* Government Organisation for Defence Procurement and Civil Aerospace Cmnd 4641; HMSO, 35p.

New ministerial appointments have also been announced, consequent on the changes, as follows:—

Lord Carrington, Minister of Defence, becomes additionally Minister of Aviation Supply. Mr F. V. Corfield, formerly Minister of Aviation Supply, becomes Minister for Aerospace in the Department of Trade and Industry; Mr Ian Gilmour becomes Minister of State for Defence Procurement, MoD; Mr David Price becomes Parliamentary Under-Secretary of State, DTI; and Mr Geoffrey Johnson Smith becomes Parliamentary Under-Secretary of State for Defence for the Army, MoD. Another change announced is that Sir Ronald Melville, Permanent Secretary MoAS, will report to Lord Carrington following the latter's appointment as Minister of Aviation Supply. When the Procurement Executive becomes operational later this year, Sir Ronald will hand over to its Chief Executive, Mr Rayner; and at that time a new appointment will be announced for him.

On the time-scale of these changes, the Chief Executive and other principal officers of the PE are to take up their appointments full time not later than October 1 this year, so that the new arrangements can become fully operational at the beginning of the next financial year, April 1, 1972. In the meantime the staff of the MoD are to continue to carry out their responsibilities broadly on the existing basis. The Minister for Trade and Industry, with his new responsibility for civil aerospace policy, will call on the resources of the PE for technical advice and for the management and

execution of civil programmes. However, special arrangements are being made for the Concorde project: the whole of the staff on its management team will be transferred to the Minister for Trade and Industry, but its specialised supporting staffs will remain as part of the PE under the Minister of Defence.

The Ministerial Aerospace Board will consist of the Ministers for Defence and Industry, and the Secretary of State for Education and Science and the Minister of Posts and Telecommunications will also be members of it when co-ordination of space procurement policy is discussed.

Government staff concerned with the future of Rolls-Royce are to be transferred to the Department for Trade and Industry on May 1.

As for the machinery for putting the White Paper recommendations into effect, the dissolution of the MoAS will be brought about by an Order in Council and Parliamentary approval for this will be sought when the proposals are debated as soon as Parliament reassembles after the Easter recess. The new pattern of Ministerial responsibilities will come into effect when this order is made and existing staff of the MoAS transfer to the MoD and DTI respectively on that day.

In the report on defence procurement, which will be referred to in detail in a later issue of *Flight*, present methods of defence procurement are criticised, partly on the ground of insufficient managerial responsibility for carrying through a whole task within the Ministry concerned. The report quotes from Gaius Petronius in AD66 that "every time we were beginning to form up into teams, we would be reorganised. I was to learn later in life



that we tend to meet any situation by reorganising and a wonderful method it can be for creating the illusion of progress, while producing confusion, inefficiency and demoralisation." This analogy refers to the successive defence procurement organisations—the Ministries of Supply, Aviation, Technology and Aviation Supply—which have been formed and tried over the past two decades, and which the new Procurement Executive is intended to replace.

The Society of British Aerospace Companies, one of the organisations consulted by Mr Rayner's team, has welcomed the White Paper. SBAC commented: "We consider the recommendations of the report to be a very sensible solution to the problems of the relationship between the Government and the aerospace industry, and we welcome them."

VFW 614 in the Open

Rolled out on April 5 from the Bremen factory of VFW-Fokker (see facing page), the VFW 614 faces a potentially rosy long-term sales outlook. But some uncertainty was expressed at the ceremony over the pricing policy of Rolls-Royce, who together with Snecma supply the M45H turboprops for the 40-seat feederliner. The Germans are worried by the fact that the development costs of the engine have risen from about £20 million to £31 million. The German Government originally agreed to cover

SENSOR

McDonnell Douglas and GE have made no moves to try to persuade the TriStar airlines to switch to DC-10s and do not intend to do so. If the TriStar airlines approach MD they will be welcomed but Mr McDonnell's policy, no doubt with Congress's views on monopoly in the background, is that there will be no knocking of a competitor. The Delta DC-10 order came as much of a surprise to MD as it did to the rest of the airlines.

The first specifically military Islander variant is at present being fitted with role equipment and external store carriers. The aircraft is to be called the Defender and is designed for long-range patrol, search and rescue or casualty evacuation work. Four underwing mountings will allow the carriage of external fuel, flares or rocket pods and the cabin will be adaptable for cameras, stretchers or gun installations. The Defender will be displayed at Paris.

The RAF is looking for a new medium-range jet transport to replace its Britannias and is proposing to rationalise its requirements with those of the airlines. The MoD Procurement Executive will be looking for a specification that will be saleable to civil users. The Britannias' life in RAF service appears to be assured until well into the '80s.

One of the first new projects to be launched by the Ministry of Defence after taking over the military MoAS is a new electronics countermeasures (ECM) system. This will provide British industry with the ability which the RAF requires to remain ahead technically in this highly advanced area and the ability to react quickly with new avionics hardware to constantly changing threats.

The RAF is expected to come up with a new requirement for a very short-range, highly manoeuvrable "dogfighting" missile. Hawker Siddeley's project is one of three likely to be short-listed. The Matra 550 may be bought if the cost and timescale of a completely new weapon are unacceptable. The RAF is also looking for new ordnance missiles to cause greater "runway craterage".

Some senior members of BOAC and BEA believe that a merger is likely before the end of this year, perhaps very soon after the Civil Aviation Bill becomes law. Both boards are unanimous in their anxiety to avoid prolonged uncertainty.

The throttleable Adour reheat system on the Jaguar in the engine-out approach case has still to be demonstrated to the satisfaction of the RAF and the FAF. Techniques to overcome the difficulty are available, however, and it is felt to be only a matter of time before a completely stable reheat system is achieved by Rolls engineers.



Ferranti's First The modified RAE Canberra B.8 used for development flying by Ferranti is seen following the first flight carrying the laser ranger and marked target seeker. The equipment occupies the nose bay previously employed for the development of Airpass attack radars and INAS systems for the Harrier and RAF Phantom. On the flight was, left, Bill Roberts, flight-test observer, and Len Houston, Ferranti chief test pilot. On the right is John Mabblerley of RAE Farnborough

Bremen Roll-out Surrounded by the press and technicians, the VFW 614 (left) was pulled out of its assembly hangar at Bremen on Monday, April 5. First of three prototypes, it is expected to fly during the summer with airline deliveries beginning in 1973. In all 26 options have been placed by airlines

half the development money for the engine, and has been asked by Rolls-Royce to pay half of the extra costs. There is no definite agreement over the matter at present but the roll-out audience was assured by both VFW and German Government representatives that both the British Government and company were aware of their obligations and that a solution to the difficulties would be found. A British Government decision is expected next month.

Presidential Concorde

Considerable significance can be read into the proposed flight in Concorde 001 by French President M Georges Pompidou on May 7. He will board the aircraft at Orly or Le Bourget and fly supersonically over the Atlantic before 001 returns to Toulouse. A Caravelle carrying the rest of his group will make a direct flight to Toulouse. The President's tour of the Aérospatiale plant at Toulouse, where he will address the workers, is his first official visit outside Paris since he came to office.

TriStar Talks Continue

Talks between Mr Daniel Haughton, chairman of Lockheed, the airlines which have ordered the TriStar and the consortium of 24 American banks

had still to be finalised as *Flight* closed for press.

Delta Airlines, with 24 of the aircraft on order, has stated that it is unable to finalise any agreements until after the next quarterly board meeting at the end of April. The other airlines are expected to have announced their intentions before then. Delta recently ordered five DC-10s with General Electric CF6 engines—the type it would like to be installed in the TriStar.

Eastern Airlines, although having recently affirmed its confidence in the TriStar, has said that it is also looking at alternative aircraft as a safety measure.

New Master for Guild



Mr A. P. W. Cane was installed as master of the Guild of Air Pilots and Air Navigators on March 29, succeeding Capt Norman Bristow. Mr Cane, operational adviser to the Aviation Division of Smiths Industries, served with BOAC from 1941 to 1964. He was flight superintendent of the Comet fleet and subsequently played a major

WORLD NEWS ...

part in the introduction of the VC10 into service. Asked at a press conference on April 5 to express the Guild opinion regarding the location of the third London airport, Mr Cane said that its committees favoured Foulness and regarded the environmental aspect of the siting as of prime importance. On supersonic transport, Mr Cane pointed out that the Guild had established an SST committee ten years ago; the Guild believed wholeheartedly in the future of the supersonic airliner and the Concorde in particular. Inevitably there would be restrictions on overland supersonic flight for a time but so for a time had there been a requirement for a red flag to precede a motor car.

EEA Concern for Future

Speaking at the annual luncheon of the Electronic Engineering Association last week, the retiring president, Mr P. A. Allaway, said that his members were very concerned with the problem of keeping ahead in technology and know-how in the climate of international projects. It was no secret that the industry had not come out well in the arrangements so far made. If Britain were to maintain a viable electronics industry, it was essential that it received a sufficiently large share of the business to enable it to keep ahead, at least in some avionic systems. The speaker believed that there

should be some state-of-the-art avionic projects not tied to particular aircraft.

The association, went on Mr Allaway, questioned the Government's policy of disengagement from industry. It undoubtedly had a role to play in the advancement of technology, as a customer with frequently special requirements. It should also support large-scale and novel projects where there was a national need on social or economic grounds. Stimulus should be given for innovation through incentive or joint ventures where short-term commercial pay-offs could not be predicted; this would become ten times more important if Britain joined the Common Market. Support would be needed; the electronics industry would no longer be content to play second fiddle in joint exercises, watching its competitors being built up "on the excuse of Britain's predominance in aircraft engines."

Replying for the Government, Sir John Eden, Minister for Industry, said he appreciated the industry's concern at "being a poor third" after airframes and engines. He went on: "Let me assure you that this Government is determined to get the balance right in obtaining the maximum possible share for the whole of the UK industry. But we will also bear in mind that without these multi-national projects we could not sustain the scale of research, development and investment required."

The new president is Mr W. R. R. Haines, managing director of the Plessey Electronics Group.

"FLIGHT" NEXT WEEK ...

... will contain the second Concorde supplement detailing the engine and maintenance aspects. There will also be a report on the BAC Rapier missile and a review on the RAF's heavy-lift helicopter requirement.

SH-2D First Flight

The Kaman Seasprite SH-2D, contender for the US Navy Lamps competition (*Flight*, October 2), made its first flight recently at Kaman Aerospace Corp, Bloomfield, Conn. Test programmes are now under way to prove the helicopter's newly installed equipment for ASW (anti-submarine warfare) and ASMD (anti-ship missile defence), prime purposes of the Lamps (light airborne multi-purpose system) programme for which the SH-2D has been designated.

Sir Christopher's Award

A cheque for £150,000 was given last week to Sir Christopher Cockerell by the National Research Development Corporation for his invention of the hovercraft. Before receiving it Sir Christopher, since 1958 consultant to the NRDC company Hovercraft Development Ltd, signed a statement saying that he was satisfied with the settlement and that he relinquished all financial rights to his invention. He intends now to continue with his own research into hovercraft.

Parliament

Asked by MR LESLIE HUCKFIELD (Lab, Nuneaton) to make a further statement about the effect of Linesman/Mediator on the reduction of air traffic congestion, Mr Noble said in the Commons on April 5 that operational experience to date had confirmed that the traffic handling capacity of Mediator was superior to that of the previous systems which it had replaced. There was no doubt that the new system would help to minimise traffic congestion and that later stages would bring further benefit. He added that he had not received a report on the system from the Guild of Air Pilots and Air Navigators.

The Minister without Portfolio, Lord Drumalbyn, told LORD MERRIVALE in the Lords on April 6 that the Government had approved fare increases between London and Gibraltar of 15 per cent on first-class fares and economy-class mid-week excursion

fares in the summer peak period and ten per cent on economy-class normal fares and the other excursion fares. There were no increases in inclusive-tour fares. He added that these changes were broadly in line with changes in international fares to places in neighbouring countries.

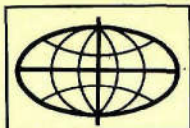
Asking the Government what reply they had had to their proposals last December to the Portuguese aviation authorities for the establishment of a **Gibraltar Airways service between Gibraltar and Lisbon**, LORD MERRIVALE was told by Lord Drumalbyn, Minister without Portfolio, in the Lords on April 6 that the latest communication on the subject was a letter from the DTI to the Portuguese Director-General of Civil Aviation on December 15, 1970. He regretted to say that no reply had yet been received.

Replying to MR DAVID MUDD (Con, Falmouth and Camborne) who had asked the Minister of Aviation Supply if he would undertake not to hold further **Concorde test flights over Cornwall**, the Parliamentary Secretary, MoAS, Mr David Price, said "no" in a written answer on April 6, adding: "These flights are an essential part of the Concorde programme. The route down the west coast was chosen

after very careful examination of alternatives, and remains the best one, meeting the technical, safety and air traffic control demands whilst affecting the fewest people."

Asked by MR JAMES RANKIN (Lab, Govan) to make a further statement "on the negotiations now proceeding designed to save the RB.211 engine," the Minister of Aviation Supply, Mr Frederick Corfield, said in a written answer on April 6 that, following the talks the Government had had with the US Government and Lockheed Aircraft Corporation, Lockheed was having discussions with its customer airlines and banks about the terms on which the TriStar with RB.211 engines might go ahead.

Answering MR JAMES ALLASON (Con, Hemel Hempstead) what steps he was taking to restrict **night flying by charter aircraft**, the Minister for Trade, Mr Michael Noble, said in the Commons on April 5 that restrictions were imposed on the total number of night jet movements during the summer months from Heathrow and Gatwick. None was used for charter flights at Heathrow. He added that his department had no power to impose similar restrictions at known BAA airports but that the other airport owners did so.



AIR TRANSPORT

VFW 614 ROLLS OUT

WITNESSED by a large and enthusiastic crowd of guests and workpeople, the 40-passenger short-haul VFW 614, Germany's first commercial airliner to be built since the pre-war Condor, was ceremonially rolled out at VFW-Fokker's Bremen plant on Monday, April 5, later taxiing under its own power.

The aircraft is one of three prototypes which will be used for the flight development programme which is scheduled to begin this summer. This is expected to continue for some 18 months and, according to VFW, deliveries of production aircraft will start at the beginning of 1973.

Options for the VFW 614 currently stand at 26, but VFW-Fokker says that there are some 460 airlines which can be regarded as its potential customers. With a world demand for some 1,200 to 1,400 aircraft of this type during the next ten years, VFW says it aims to capture some 30 per cent of this market, or 400 aircraft, with the 614.

With a wingspan of 70ft 6in, 21.5m and an overall length of 67ft 6in, 20.6m, the 614 has an operating empty weight of 26,900lb, 12,200kg, and a maximum take-off weight of 41,000lb, 18,600kg, with a payload of 8,200lb, 3,720kg.

MARKING ON THE BILL

BRITAIN's new Airways Board could be left with "too little authority." This warning was sounded on April 1 by BEA chairman Mr Henry Marking. He points out in the April edition of *BEA Magazine* that the board will certainly take over the authority presently vested in the two air corporations. But, he adds, the industry should be concerned lest the Airways Board should itself be left with too little authority to exercise proper commercial judgment, while the real power lies with the Secretary of State—"and this can, in effect, mean with departments of Government."

In the meantime, Mr Marking advocates keeping an open mind on the organisational problems, and securing the position of BEA as an "efficient and profitable airline in each of its several spheres of activity."

Mr Marking, who—with BOAC chairman Mr Keith Granville—will be a member of the Airways Board, says that it may take one of two forms. He considers that much will depend on which of these forms it takes. It could either be a holding board which would have its own experts such as a financial director who would be staff officers to the chairman, and this, as Mr Marking understands it, is what the Edwards Committee recommended; or it could be a board which would include amongst its membership executive such board members as the personnel director, operations director, chief engineer and so on, who would have managerial authority over the two corporations.

If the board took the second form, the BEA chairman thinks, it would bring the effective merger of BEA and BOAC much closer, but the question of merger is the first task that the new board will have to consider, so he very much hopes that the first appointments to the British Airways Board will not in effect pre-empt the board's decision on this matter.

● Mr Keith Granville is expected not to issue any statement about the board at this stage.

Take-off field length is 3,890ft, 1,180m and range with maximum payload about 415 statute miles.

The aircraft is powered by two M45H turboprops. These have been designed specifically to meet the stringent requirements of the VFW 614's short-haul flight operation, and they represent the first of a new generation of aircraft engines for which, it is claimed, fuel consumption, reliability and maintenance will achieve higher standards than ever before. Development and production of the M45H is the second major collaborative programme between the Bristol Engine Division of Rolls-Royce and Snecma, who, of course, are also jointly developing and producing the Olympus 593 for Concorde.

The first M45H engine made its maiden run in January 1969, and by the first quarter of 1971 more than 1,300 test hours had been logged by the six units involved in the bench development programme. A total of 15 flight engines is being built for the three prototype 614s.

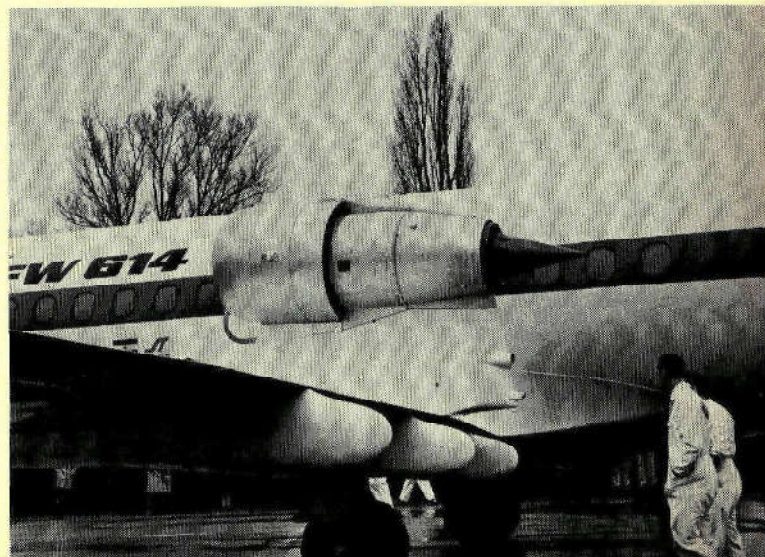
Speaking at the ceremony, Mr H. G. Conway, executive director of Rolls-Royce (1971), said: "We are quite happy with the performance of the engine so far." He added that it was mechanically excellent and "will set new standards of silence for aircraft of this type."

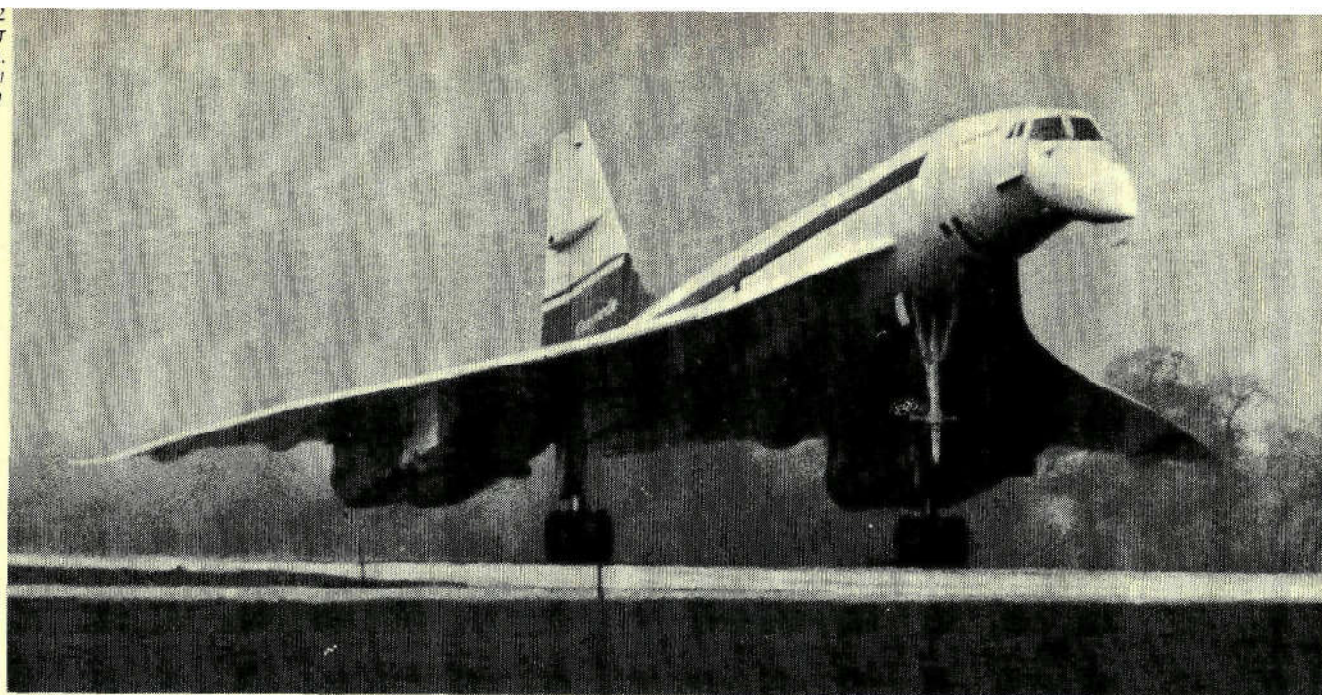
BAA TAKES TURNHOUSE

A PROMISING future for Turnhouse Airport, Edinburgh, with benefits for the whole of East Central Scotland, was forecast by the Minister for Trade, Mr Michael Noble, on April 1. He was speaking after the hand-over of the airport from the DoTI to the British Airports Authority. He noted that the Government had agreed to pay up to £6½ million towards the £9 million cost of building a new terminal and runway which he considered essential for the continued expansion of light industry in the area.

Mr Peter Masefield, chairman of the BAA, noted that the new runway, due to be completed late in 1974, would

The Rolls-Royce/Snecma M45H is shown to good effect in this roll-out shot of the VFW 614 at Bremen





AIR TRANSPORT...

face into the prevailing wind and be capable of handling the expected traffic growth, mostly from IT flights, many using the new generation of airbuses. About 700,000 passengers are expected to use the airport this year (short-term improvements are being made to cater for them), and this figure should rise to 900,000 by 1974. The new passenger terminal should be opened by the spring of 1975.

CONCORDE FLIES AGAIN

FOLLOWING a period on the ground since the end of January, Concorde 002 resumed its flight-test programme from Fairford on April 3. A series of strengthening modifications has been carried out to the intake control mechanism following the failure which occurred during a flight by 001 on January 26. The French-assembled aircraft is also due to resume flying shortly.

The flight of 002 from Fairford lasted two hours, including 44min at supersonic speed. The aircraft reached Mach 1.7 and a maximum height of 48,000ft over the North Sea. Mr Brian Trubshaw was in command, with Mr John Cochrane as co-pilot, while Mr George Wood and Mr Brian Watts were the navigator and engineer respectively. Three flight-test observers completed the crew complement.

The basic Concorde test flying programme should be completed by June when 002 will start to concentrate on engine development, following investigation of the low-speed handling regime. An Olympus Mk602 with annular, no-smoke combustion chambers and vaporising burners will probably be tested in 002 this autumn. Prototype 001 will begin systems testing after the Paris Air Show at which both Concorde should be demonstrated. The first of three consecutive Concorde supplements appears later in this issue.

JAPANESE DEVELOPMENTS

THE second largest strictly domestic Japanese airline (after All Nippon) has been formed by the merger of Toa Airways and Japan Domestic Airways into Toa Domestic Airlines. Stockholders were expected to have approved the merger yesterday, with formal business to commence on May 15. In a year's time TDA will start to

Concorde 002 touches down at Fairford after a successful first test flight following its intake modifications

buy four or five jets, probably 727s or 737s, and hopes to begin jet services by the end of March. It has 28 YS-11s and two Herons on its books at present, but is looking for buyers.

All Nippon Airways wants to dispose of its full fleet of 27 Fokker F.27s by the end of March 1973, and at least 11 of the current fleet of 30 YS-11s will be sold by the end of March 1974. ANA recently sold one YS-11 to Merpati Nusantara Air Lines of Indonesia. Meanwhile, Namco is gearing up its sales campaigns in Africa and South-east Asia; it recently sold a YS-11-200 to Southwest Airlines, an inter-island carrier in the Rykyu chain, south of Japan.

Air Inter Caravelle 12s Five Caravelle 12s will be added to the Air Inter fleet during 1973 for services to begin in April of that year.

Ansett Airlines has applied to the Australian Department of Civil Aviation for permission to operate charters overseas initially to New Zealand and later to Britain and Europe.

One-Eleven 475 Flies The first production BAC One-Eleven 475 flew for the first time on April 5, some three weeks ahead of schedule. It will be delivered to Faucett of Peru in July to begin service coincidentally with Peru's 150th anniversary celebrations. Until that time it will fly alongside BAC's own prototype 475 in a certification programme which is well advanced.

747 Freighter Production The swing-up nose, cockpit and lower forward fuselage for the first Boeing 747F freighter have arrived at Everett ready for assembly of the aircraft this summer. The sections are being fitted together this month for lengthy recycling tests to prove the hinge mechanism. The 747F will be rolled out in October and is scheduled to be delivered to Lufthansa in March next year, in time for services to begin between Frankfurt and New York during May. Six return flights a week are planned. A photograph appears on page 516.

An authority without authority

Next week Britain's new Civil Aviation Bill (*Flight* March 25) goes to the Committee stage in the House of Commons. For several weeks a two-party group of 16 MPs will try to persuade Mr Noble to amend and improve it in minute detail. Eventually it will go to the Lords, and it should become law in the autumn. In this article J. M. Ramsden suggests that this Bill, which will profoundly influence Britain's civil aviation industry—operating and manufacturing—during the next ten or even twenty years, sadly fails to catch the mood of the country for less busyboding by government officials, more care for the consumer, more individual responsibility for professional creative people, and more information and explanation from those who rule us.

THIS NEW LEGISLATION is really about the management of modern Britain. Its first concern is the airline industry, an increasingly important part of the economy. But it is more than a new set of rules for civil aviation. It is about the delegation of central government to professionals; and the principles involved should matter to everyone who cares about the success of Britain.

To quote from the 1968 Fulton Committee report on the Civil Service: "Siting a new airport, buying military supplies . . . compel civil servants to use new techniques of analysis, management and co-ordination which are beyond those not specially trained in them." British aviation will say aye to that.

We see no need to transplant the ARB, for 34 years Britain's most successful civil aviation authority. Nor is the creation of a British Airways Board, which provides for a BOAC-BEA merger, one of British civil aviation's highest priorities. But the Civil Service is to be congratulated on the thought behind the idea of "hiving off" civil-aviation regulation to a public corporation named the Civil Aviation Authority—as suggested by the Edwards Committee which reported two years ago.

The Civil Aviation Authority is not, as Mr Noble told Parliament during the Bill's second reading on March 29, a "constitutional innovation"—the first time the Government has "hived off a regulatory function." There are precedents, even in the civil aviation field. The first was the formation 34 years ago of the Air Registration Board, to which the State delegated extremely specialised technical responsibility for the regulation of civil airworthiness. More recently, in 1960, the Air Transport Licensing Board was set up—with fewer strings than the Government intends the CAA to have—to look after the highly commercial aspects of air routes and domestic fares; and in 1966 the Civil Service transferred day-to-day responsibility for Britain's major airports to the British Airports Authority.

But one of the first principles of good commercial management, whether you are running aviation or a sweet shop, is that, having delegated responsibility, you must delegate authority. If you do not do this, and are always

meddling with or making or reversing policy and decisions, you will frustrate and demoralise your managers, fail to attract the best people, and will eventually crack up yourself.

Thus was the Air Transport Licensing Board's spirit broken (though some of its annual reports were outspoken about the interference it had to suffer), and thus did one Minister—overwhelmed by insoluble problems—send for Sir Ronald Edwards.

For the Civil Aviation (Licensing) Act of 1960 had gone wrong. Mr Duncan Sandys, the minister responsible for that Act, gave all kinds of assurances to Parliament that the powers the Government was retaining over the Air Transport Licensing Board would be used sparingly if at all. These promises were not quite remembered by his successors. The fourteenth in direct line from Sandys actually looked for and found some small print which he claimed gave him the power to override the ATLB completely (on the transferring of route licences).

What matters is not what ministers say, but what is on the statute book. Ministerial assurances that the Civil Aviation Authority *will* have authority are of no worth at all. In saying this we mean no disrespect to Mr Noble. There is no assurance that the next man in the job will be anything like as handsome as he is.

The first management failure came when a minister even more good-looking than Mr Noble reversed the 1961 Air Transport Licensing Board (ATLB) decision to award an independent restricted-frequency service between London and New York in competition with BOAC. This and other independent scheduled route awards, including London-Paris, for which the minister never bothered to get traffic rights, were made after full and fair examination of all the issues at public hearings and in proper accordance with the terms of the Civil Aviation Licensing Act. The licences were vetoed on appeal to the Minister, who, of course, has responsibility for both BOAC and BEA.

The Edwards Committee took the view, in its report of April 1969, that competition was good for civil aviation and that independents should be allowed on London-New

"The satisfaction of the consumer should be the primary objective of civil aviation"



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York and London-Paris routes. Which was what the expert body had found seven years before, only to be overridden by the Government. Now, as we shall see, it is proposed to set up a replacement body and to retain over it even greater powers of interference. Make some mistakes, but do not make them twice.

The Edwards report correctly perceived that the licensing system lacked overall policy. What Edwards failed to perceive, though it was the cause of the failure that had led to his being sent for, was that the licensing body needed the authority to shape its own policy, not to have policy imposed upon it.

Thus does the Civil Aviation Bill propose to give the Government supreme power to decide policy. The relevant section is Clause 3(2):

"Subject to the following subsection, the Secretary of State may from time to time give guidance to the Authority in writing with respect to the performance of the functions conferred on it otherwise than by this subsection; and it shall be the duty of the Authority to perform those functions in such a manner as it considers is in accordance with the guidance for the time being given to it in pursuance of this subsection."

Guidance for the CAA

The next subsection (3) requires that this guidance must be approved by Parliament. This will not deter a Government determined to make the CAA do its bidding. In any case what sort of guidance is the Government going to give? General stuff of the sort outlined by Mr Noble during the second reading? If so, write it into the Act.

Detailed policy guidance, done once, will gather its own momentum; and more and more civil servants will be needed to advise whatever political authority happens to be in office. One Minister who tried to prescribe policy—Mr Roy Jenkins in 1965—saw it stood upon its head within two years. He had said in so many words "no more competitive scheduled services for the independents, but they will be given a clear run on inclusive tours." Within ten months the same minister—and he was one of the ablest we have had—allowed increased independent frequencies and a third carrier on domestic trunk routes, while a successor later approved the formation of BEA Airtours to compete with independent inclusive tours.

Detailed policy pronouncements from on high may also prompt prolonged arguments about what the Minister meant by this or that word. The civil servant who produced the wording may well have moved on to another job, and the airline industry itself may have moved on to new ideas. One year the craze is contract bulk inclusive tours, the next year it is something else. Air transport is a dynamic, unruly industry which will not fit into preconceived policy boxes. Air transport regulation is essentially a case-by-case business. The right policy orbit is achieved with small mid-course corrections by the crew, not by sudden burns ordered from a remote Whitehall control centre.

The word guidance in 3(2) is in any case a weasel word for directive because the section goes on to say that it is to be "the duty" of the Authority to follow the guidance. Admittedly the Authority should do this in the way "it considers" is in accordance with the guidance (our italics). But these words are really only like giving the CAA a choice of colour for its iron bars.

Amendment: Write 3(2) guidance into the Act.

Section 3(1) needs amending to give the Civil Aviation Authority terms of reference more inspiring than:

"It shall be the duty of the Authority to perform the functions conferred on it otherwise than by this section in the manner which it considers is best calculated:

"(a) to encourage British airlines to provide air transport services which satisfy all substantial categories of public demand (so far as British airlines may reasonably be

expected to provide such services) at the lowest charges consistent with a high standard of safety in operating the services and an economic return on the sums invested in providing the services and with securing the sound development of the civil aviation industry of the United Kingdom."

What is the significance of the word "substantial"? And what means the apparent back-hander in parenthesis? Something more inspiring is needed, with a coat-of-arms simplicity about it—to the effect, for instance, that the CAA's job is "to secure that British airlines provide economic, safe and efficient air services in the interests of the consumer and of the nation."

There is no mention of efficiency, nor is there enough emphasis on the needs of the consumer. Indeed, the emphasis on air services that give "an economic return," though sensible in itself, could be a mandate for fare increases unless it is balanced by an emphasis on efficiency and good management. The CAA should ask why, for example, one British airline loses money on London-Belfast with a 70 per cent load factor while another makes a profit on the same route with a 46 per cent load factor.

Somewhere in the Act, or the Regulations, provision should be made for consumer representation in all proceedings—for someone to do properly and professionally what Citizen Lucking has tried to do in his amateur but remarkably energetic and effective way. The ATLB has said that it believed that it represented the consumers: and though it has done better as it gained experience, the members often lack "feel." A question from the early days "why do passengers prefer pressurised aircraft?" has been echoed recently by apparent puzzlement over the appeal of jets. Airlines have produced biased examples of allegedly analogous overseas fares by missing out the high-density routes in Australia, or citing notorious IATA "toll" routes such as Copenhagen-Hamburg. A permanent professional consumer advocate would deal with such behaviour very smartly. This reform becomes crucial if the main hearings are in future to be before a single "examiner."

The consumer, who is making his presence felt much more these days, is even deprived of the rights he had under Section 4 of the old Act to make representations to the licensing body. No such right is conferred by this Bill, and yet satisfaction of the consumer, as Edwards said, should be the primary objective of civil aviation.

Private airline rights

Paragraph (b) of Clause 3(1) enjoins the CAA "to secure that at least one major British airline which is not controlled by the British Airways Board has opportunities to participate in providing, on charter and other terms, the air transport services mentioned."

What is the significance of the word "charter"? We know that the law officers of the Crown do not like the word scheduled, because it defies definition, but why the emphasis on charters?

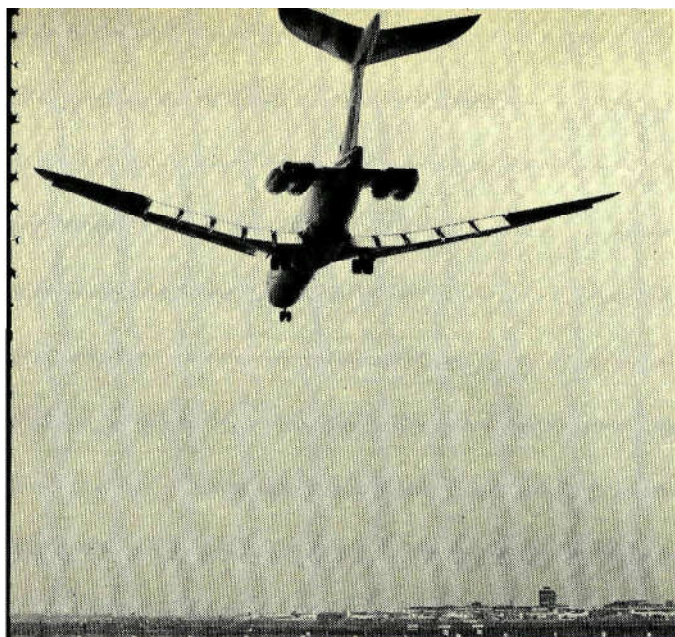
Amendment: In Clause 3(1) why not just say "air transport services of all kinds"?

Though Subsection (1) of Clause 4 appears to give the Minister powers over the CAA only in the event of a "great national emergency," some future minister is going to find that subsection (3) gives him much wider scope. It could allow him to give the Authority "directions of a general character [in] matters appearing to him to affect the national interest." Does "the national interest" include the economic health of the airline industry? And bilateral air traffic agreements? As this Clause stands a future minister may interpret it thus and use it to override the CAA. It might prove ideal, for example, for justifying an expediency such as the recent route transfers.

Amendment: Delete Clause 4(3).

The already notorious Clause 4(4) reads:

"The Secretary of State may, after consultation with the Authority, give to the Authority directions requiring the Authority to secure that a particular thing which it is doing is no longer done by it, or that a particular thing which it has power to do and is not doing is done or not



done by it, if the Secretary of State considers it appropriate to give such directions."

The Bill primarily relates this "terminological sludge," as one MP called it during the Bill's second reading, to the United Kingdom's obligations to international organisations, for example, Icao. But paragraphs (b) and (d) appear to allow these powers of intervention in respect of bilateral agreements. In other words, if the CAA approves an improvement in services which happens to upset the Ruritians, Clause 4(4) gives the Minister the power of veto without consultation or even explanation.

Amendment: Clause 4(4) (b) and need additional phrase such as (d) "with the exception of air traffic agreements."

It is agreed that supreme power in traffic-rights matters must rest ultimately with the Secretary of State. But at the moment, as we shall see, the Bill does not—as Edwards recommended—even require the Minister to consult the CAA. Traffic rights are the key to every international licence for which the CAA is being given responsibility, yet the Minister will remain exclusively responsible not only for these but also for granting UK rights to foreign charter companies, a function that cannot be isolated from the CAA's job of licensing of British carriers on the same routes.

Nor does the Bill give the CAA any authority of any kind on international fares. This responsibility will remain in the Government, and there is nothing in the Bill that requires consultation. The airlines will, as now, go direct to the civil servants to chat about international fares and matters concerning Iata without reference to the Authority. The CAA is to be given responsibility for the regulation of Britain's international air transport, yet it is given no say of any kind either on traffic rights or on pricing policy, as Edwards recommended.

How can the Civil Aviation Authority do its job if it is not even consulted on these key economic regulators? The idea is preposterous.

Similarly, the CAA is given responsibility for air traffic control services but is specifically prohibited by Clause 9(7) from exacting air navigation charges. Responsibility for these will remain with the Minister.

Amendment: New clauses should be inserted giving the CAA authority to take the initiative in and administer Britain's traffic rights agreements and Iata fares.

The greatest scope for gerrymandering is in Clause 24. This gives the Minister the power to tell the CAA to suspend a hearing if he thinks that the Clause 3(2) policy guidance has suddenly gone on the blink. Clause 24(2) reads in part:

"until he has decided whether to do so [rewrite the policy guidance] the Authority ought not to perform one

or more of the functions conferred on it by Section 22 or 23 of this Act, he may give the Authority a direction requiring that, either generally or in any case or class of case specified in the direction, the Authority shall not perform any of those functions which is so specified until the Secretary of State cancels the direction."

This clause should be deleted. It would be bad enough if the Authority's policy were to be decided by the Government under 3(2); it would be intolerable if, were these policies to be suddenly shown to be half-baked—as history suggests they would—the Minister could literally hold up the Authority's day-to-day work while he thought up a better policy—or even, as the wording allows, to suspend it indefinitely.

Amendment: Clause 24(2) should be deleted.

Clause 24(7) sets out the power to prescribe appeals regulations:

"Conferring on persons of prescribed descriptions a right to appeal to the Secretary of State from any decision of the Authority with respect to [a licence] or to [with respect] an application for a licence;

"(b) authorising the Secretary of State on such an appeal to direct the Authority to reverse or vary the decision in question and in consequence to do or refrain from doing such other things as may be specified in the direction."

This finally ensures that the real civil aviation authority in Britain will be the Government. The Minister is giving himself not only the power to prescribe CAA policy by 3(2), to suspend it at a moment's notice by 24(2), to decide international fares and traffic rights, and to direct the CAA not to do anything 4(4). He also proposes to make himself the final court of appeal by 24(7).

And, having done all that, he will look Parliament straight in the eye and say he doesn't really mean it, of course the CAA will be independent, and it'll all be all right on the night.

Appeals should be allowed only on points of law, or on genuine new evidence. They should certainly not be disposed of by a person with a vested interest in one of the interested parties—because 99 times out of 100 the appellants will be the airlines owned by the appeal court. As Edwards recommended, appeals should be to a judicial tribunal.

Grounds for appeal

Stunningly, this appeal clause does not even define the grounds on which appeals are to be allowed. The explanatory preamble to the Bill says that appeals may be made "on any grounds"—not, as Edwards recommended, on the grounds of a misinterpretation of ministerial policy guidance.

Finally, the Bill does not even require the Minister to explain his reasons for an appeal decision. Perhaps the associated regulations will provide for publication; but the need for governing man to explain himself is nowadays so important that this should go into the Act itself.

Amendment: Clause 24(7) should be amended to allow appeals against CAA decisions only on points of law, or materially changed and unforeseeable economic circumstances; they should be made to an independent judicial body; and the decision should be published.

Clause 20 tells the Authority what it must put in its annual reports. These must include Ministerial directives under Section 4 (national interest) and under Section 24(2) (don't move while I'm thinking). Such publication will certainly deter abuse of these powers. But note that this clause gives the Minister the power to tell the Authority not to publish a directive given under Section 4 if it is in his opinion "against the national interest to do so." In other words, if Air Ruritania will not allow an improvement in services between London and Strelsau, this is to be exclusively a matter for the Minister, and nothing whatsoever to do with the CAA.

The CAA should also be required to publish its reasons for disagreeing with the ARB—should it ever dare to do so.

Amendment: Clause 20 should be amended to ensure that CAA annual reports record all Ministerial directives. Words should be added to exclude from the meaning of



The Bill reviewed on these pages specifically requires the Civil Aviation Authority "to secure that at least one major British [private] airline has opportunities . . ."

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"the national interest" bilateral air traffic agreements.

One of the greatest weaknesses of the existing system, apart from ministerial interference, is the famine of economic data on British civil aviation. We wonder how many thousand man-years have been wasted trying to discover traffic figures or load factors on this or that route, or even simple operating costs.

The Bill gives the Authority the power to call for information (34) but seems to be trying in 5 and 35 to make publication even more difficult than it is now. Clause 5 gives the Minister the power to direct the Authority by regulation not to publish anything that might upset the owner of the information. This is reinforced by Clause 35, which again accentuates the negative, requiring the Authority not to publish anything unless the person concerned has consented in writing—even though in 35(2) (a) the Minister entitles himself to give the information to, say, Icao.

As these words go to press, the CAB sends *Flight* yet another document publishing more information about a British airline than is published in Britain. For example, Britannia Airways is forecasting revenue from its first year transatlantic charter programme of \$996,000 and expenses of \$897,600. This is the sort of information which this Bill will allow Britannia to keep secret. A British citizen who wants to know the cost, revenues, capital, and aircraft purchase arrangements of independents like Britannia, Lloyd, Laker, British Midland, Caledonia/BUA and others can walk into the CAB office in Washington and get it; yet this Bill, in Clause 61, actually applies the Official Secrets Act to any employee of the CAA who discloses exactly the same information. The fullest and most intimate financial data about every American airline for the year ending September 30, 1970, also arrived in the *Flight* offices last week from the CAB Bureau of Accounts and Statistics.

Clearly it is reasonable that the Authority should respect certain commercial privacies. But this Bill is about civil, not military, aviation—it is about public transport, not about defence. Secrecy should be the exception, not the rule.

Statistics are so important that publication should be positively legislated for, obliging the airlines to return their cost and traffic results, and empowering the Civil Aviation Authority to collect and publish this managerially essential raw material. Instead we get negative, half-hearted stuff like "regulations may be made entitling the Authority to withhold, etc . . ." Mr Noble was more encouraging and positive about statistics in the second reading (col 1127, March 29) but he should put something into the Act.

A number of other additions or amendments are needed to clarify and improve this Bill.

Clauses 29, 30 and 31, and Schedules 2, 3 and 5, which give the CAA Scottish airports at present owned by the DoTI, are full of sections about the purchase of land, health control, and the "waiting of hackney carriages." One suddenly realises that we are setting up another British Airports Authority. Would it not be more efficient to give BAA the job of running all Britain's publicly owned airports? It certainly seems illogical that a Bill which provides for one instead of two public corporations to run air services should provide for two instead of one public corporation to run airports.

Clause 33(1) (c) requires the CAA to let the Minister know if an airline merger "comes to [its] notice." Mergers, even more than pooling agreements, should not only be drawn to the attention of the Minister; they should be registered with and approved by the licensing authority, whose purpose may be defeated by mergers real and phoney (remember BOAC-Cunard). A small point, perhaps, but it is just one more way in which this Bill seems to be trying to ensure that the Civil Aviation Authority will not be the real civil aviation authority. Obviously a lot will depend on the calibre of the men chosen for the job; but the Bill as it now stands will make it very difficult to attract good men.

The Secretary of State reserves the power to:—

- Control international fares
- Control international traffic rights
- Give the Authority policy directives
- Order the Authority to suspend cases
- Decide appeals

The swing-up nose (foreground), cockpit and lower nose section of the first Boeing 747F are now being assembled at Everett. See story on page 512



BRITISH SHARE DOWN

NORTH Atlantic traffic figures for 1970 (see the table) show that traffic continues to grow fairly strongly—the number of passengers was up 20 per cent on 1969. Among airlines which suffered an overall decrease of traffic, however, was BOAC, which with a shortage of capacity (and no 747s as yet) had a very high load factor, 8.1 percentage points above the industry average.

In the USA-Europe market (Canada excluded), where the industry average was again around 20 per cent, BOAC's traffic was more than 9 per cent up. But the airline is being challenged by Lufthansa, whose traffic grew by more than 20 per cent. If the pattern continues the German airline could move up into third place this year.

In spite of current difficulties the two US airlines increased their share of the US-Europe market from a combined 35.4 per cent to 44.6 per cent, and TWA was able to raise its load factor. BOAC, with a load factor (unchanged) standing ten points above that of Pan American, suffered a decline in its share of the market from 8.7 to 7.9 per cent. Lufthansa's share was little changed at 7.4 per cent, and Air France's share increased slightly to 7.4 per cent.

Saturn has promoted Mr Monte G. Ward to the post of vice-president, operations.

British Air Services has appointed Mr J. B. Latto as travel sales manager, Mr J. H. Cox as technical planning manager and Mr R. J. Bull as economic planning manager.

Malev has begun a twice-weekly service between Budapest and Madrid via Zürich using Tu-134s. The Hungarian airline carried more than 358,000 passengers during 1970.

The first four transcontinental routes to be based on the use of area-navigation equipment will be brought into effect in the United States on April 29. The new airways approximate to great circle tracks. Announcement of a further 115 area-navigation routes by the FAA is expected shortly.

Part of the wreckage of a Caravelle which crashed into the Mediterranean in September 1968 has recently been recovered. The parts are reported to include the rear fuselage and flight recorder. Ninety-five lives were lost in the crash.

A draft amendment to the Air Navigation Order (1970) has been circulated for comment; the effect of the change is to prohibit the simulation of emergencies affecting the flight characteristics of an aircraft at any time when passengers are being carried.

One-Eleven Lease Because of a shortage of capacity, BEA is to wet-lease one of Cambrian's One-Eleven 400s this summer for use on routes to Germany. Spey spares problems recently caused some of BEA's One-Elevens to be grounded, but the situation has now returned to normal.

Pan American will use its 727s on the London-Berlin route via Hamburg from April 25. Previously they have been used only on German internal services. A non-stop Pan Am 747 flight to Washington, and continuing to Atlanta with Delta Airlines, will mark the world's first 747 interchange service.

British Air Services, holding company of Cambrian and Northeast, has appointed Mr B. J. T. Callan as its deputy managing director. He became managing director of Cambrian in 1968 and of Northeast (then BKS) in 1969; he will continue in the latter post, but is to be succeeded in the former by Mr David Davies, who has been with Cambrian since 1964.

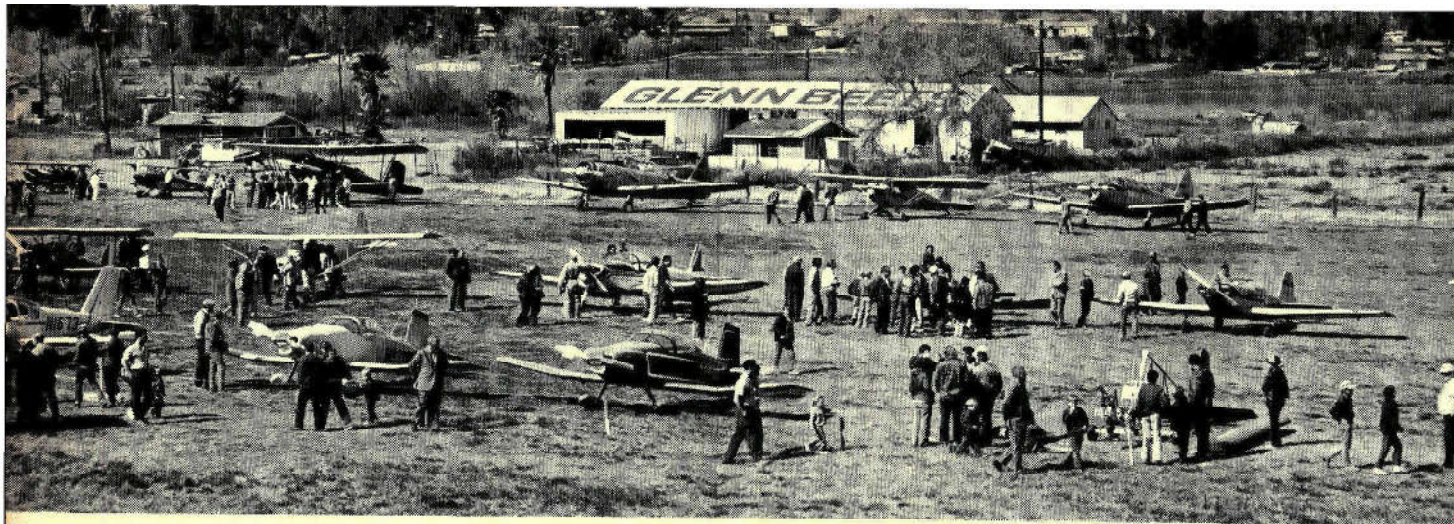
748 for Canada Air Gaspe, a small but expanding Eastern Canadian airline, has ordered a Hawker Siddeley 748. The aircraft will operate from the airline base at the town of Gaspe in Quebec, providing services this spring between the city of Quebec and Northern New Brunswick, the Gaspe Peninsula, the Magdalene Islands, Anticosti and the lower north shore of the St Lawrence.

The Court Year Court Line, one of whose subsidiaries is Court Line Aviation, had a profit before tax of £2,053,000 for the year ended September 30, 1970. Air transport interests contributed 45 per cent to turnover and 32 per cent to profits, while tying up only 8 per cent of net assets employed by the group. Ten One-Eleven 500s will, it is hoped, constitute the 1971 tour fleet. Seven One-Eleven 500s and a Series 400 carried 900,000 passengers during 1970.

NORTH ATLANTIC SCHEDULED PASSENGER TRAFFIC, 1970

Airline	North Atlantic total					Europe — USA				
	Passengers		Passenger load factor		Market share	Passengers		Passenger load factor		Market share
	No	Change on 1969 (%)	1970 (%)	1969 (%)		No	Change on 1969 (%)	1970 (%)	1969 (%)	
Pan American	1,473,571	+31.9	54.5	53.0	20.5	1,473,571	+31.9	54.5	53.0	23.3
TWA	1,345,393	+18.1	54.1	56.7	18.7	1,345,393	+18.1	54.1	56.7	21.3
BOAC	621,351	-0.7	64.1	63.4	8.6	501,635	+9.5	63.7	63.7	7.9
Air France	486,425	+21.2	52.5	51.4	6.8	465,788	+22.5	52.2	51.2	7.4
Lufthansa	479,731	+21.2	54.4	55.3	6.7	470,266	+20.5	54.6	55.6	7.4
Air Canada	413,574	+40.7	57.4	51.1	5.7	—	—	—	—	—
Alitalia	378,721	+22.4	56.0	55.7	5.2	326,697	+18.8	55.9	55.9	5.2
KLM	321,849	+12.5	53.5	57.1	4.5	277,481	+14.2	56.0	59.3	4.4
SAS	292,188	+16.3	55.5	50.6	4.1	292,188	+16.3	55.5	50.6	4.6
Aer Lingus-Irish	247,723	+25.9	68.5	61.8	3.4	241,762	+25.4	68.3	61.7	3.8
Swissair	202,688	+7.0	54.8	53.6	2.8	202,688	+7.0	54.8	53.6	3.2
EI AI	179,455	+13.7	68.6	59.0	2.5	179,455	+13.7	68.6	59.0	2.8
CP Air	171,530	+20.6	52.7	49.9	2.4	—	—	—	—	—
Iberia	166,751	+27.9	45.7	46.0	2.3	146,783	+18.6	46.9	46.7	2.3
Sabena	136,617	+8.0	53.7	47.8	1.9	116,231	+5.3	56.0	49.6	1.8
Olympic	118,298	+34.5	54.4	50.3	1.6	118,160	+36.2	54.5	50.7	1.9
TAP	57,994	+47.6	47.8	44.3	0.8	57,994	+47.6	47.8	44.3	0.9
Air-India	45,080	-4.6	49.7	52.4	0.6	45,080	-4.6	49.7	52.4	0.7
Finnair	25,233	+79.6	44.8	32.7	0.4	25,233	+79.6	44.8	32.7	0.4
Qantas*	20,206	-28.6	38.3	49.2	0.3	21,529	-23.9	37.3	49.2	0.3
JAL	16,088	-14.0	30.5	26.3	0.2	16,088	-14.0	30.5	26.3	0.3
Total	7,200,466	+20.0	55.3	54.4	100.0	6,324,022	+20.2	55.3	54.6	100.0†

* Figures for 11 months. † Discrepancy due to rounding off.

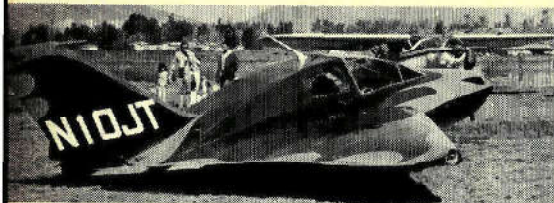
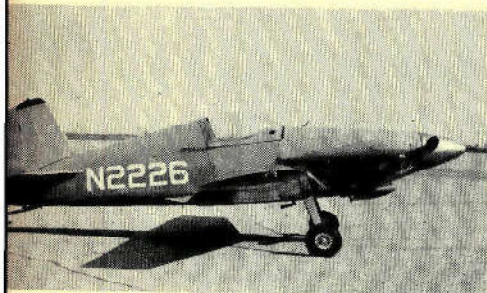


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FLIGHT
International,
15 April
1971

FLABOB FLY-IN

The No 1 Chapter of the Experimental Aircraft Association held its annual Mid-Winter Fly-In in conjunction with the Antique and Classic Aircraft Association at Flabob Airport, Riverside, Calif. Shown here is a selection from the considerable gathering of ancient and modern at this, the largest EAA event on the US West Coast.

Private Flying



Far left, top to bottom: Midget Mustang built by Ray Allen varies from the original design by having a cross-over exhaust system and a lift-up canopy. John Thompson achieved acknowledgement in his Dyke Delta registration. The canopy is slightly modified. Vern Faler's modified Smith Miniplane partially obscures a standard version. The most evident difference is the use of I-struts. This 1930 Arrow Sport was restored over six years by Dean McCarty. Left, top to bottom: Ernie Freeman's restored S-4C Scout. Designed by William B. Taylor, this all-metal, 65 h.p. Mini-Hawk made its first flight on February 5 following 12 weekends' construction. The wings are detachable and the designers claim a construction cost of \$400 plus engine. Three in a row, front to rear: VW-powered Taylor Mono-plane; two-seat Thorp T-18; single-seat Bock model 2

Photographs by Henry Artol



AIR TRANSPORT...

LIGHT COMMERCIAL & BUSINESS

JT15D deliveries The first production models of the Pratt & Whitney Aircraft JT15D turbofan engines have been delivered on schedule by United Aircraft of Canada to power the Cessna Citation.

The delivery of the first production engine followed an intensive research and development programme at United Aircraft of Canada. The engine was first run in test cells at the company's plant in Longueuil, Quebec, in 1967 and it has subsequently completed over 10,000hr bench-running. First flight-tests in a pod on the underside of a CF-100 fighter followed in August 1968 and restarting at altitudes up to 40,000ft has since been demonstrated.

In all, prior to production, ten prototype engine models were delivered for aircraft flight development in the field; in addition, nine experimental engines were used at UACL in the development programme.

During recent tests in California, the Cessna Citation demonstrated noise levels well below the requirements of the Federal Aviation Administration in the United States.

The JT15D is the second engine series to be developed by United Aircraft in Longueuil. The first engine developed and manufactured there, the Pratt & Whitney Aircraft PT6 gas turbine, now powers more than 1,425 aircraft in 70 countries.

First commuter Jetstream Voyage Wasteels, a French travel company, has placed the first firm order for a Jetstream since the project was taken over by Capt W. Bright. The aircraft will be a Mk 1 in 18-seat configuration, completed by the new company, and following delivery on July 1 it is expected to operate scheduled services based on Lille. Voyage Wasteels is to become the French agent for the type.

Tropical trials of the Jetstream 200 are about to start in the Trucial States and these will be completed before the aircraft is displayed at Paris; certification of the Series 200 is expected during June. *Flight* understands that the Jetstream is still regarded in Ministry of Aviation Supply circles as a likely contender for certain RAF requirements.

Jetstream Aircraft will move into new premises at Leavesden during June and this will be the sales and product support centre. The Sywell facility will be retained

and, in addition to the existing production potential, letters of agreement have been exchanged for a major North American concern to lay down a Jetstream production line as the market develops. Financial support for Jetstream Aircraft has been assured by both shipping and banking interests.

Stol conversion The first British-registered Cessna 337 to undergo Robertson Stol modification is about to be submitted for recertification by Rogers Aviation of Cranfield, who hold the Robertson agency for the United Kingdom and Europe. The aircraft, owned by the Croda group and operated from short grass strips, will have a modified wing leading edge, cambered wingtips, wing fences, additional fin area and a high-lift flap and aileron interconnection. Robertson claims a landing distance from 50ft, 15m of 360ft, 110m for the converted 337.

Fatal fuel shortage The ditching of a Pilgrim Aviation Twin Otter in Long Island Sound on February 10, 1970, has been attributed by the NTSB to fuel exhaustion. Inbound to Kennedy from Groton, Connecticut, the aircraft was held and the pilot subsequently chose to divert to Tweed Airport, New Haven. The first attempt at an instrument approach was unsuccessful and the aircraft set course to return to Groton. The ditching occurred shortly after overshooting and resulted in the loss of five lives.

According to the NTSB report, the pilot was not fully aware of the weather situation and as a result he did not call for additional fuel before leaving Groton.

Antarctic Porter On March 16 a Forrester Stephen Pilatus Turbo-Porter returned to Melbourne after completing its second tour of duty in Antarctica with the Australian National Antarctic Research Expedition. The Turbo-Porter and crew, consisting of a pilot and an engineer, left Melbourne on board the MV *Nella Dan* on December 12, 1970. On reaching a point 45 miles from Mawson on December 28, the aircraft was assembled on the sea ice and started flying on the next day.

During its 40 days on the Antarctic continent, of which only 26 were flyable because of the weather, the Porter flew a total of 117 sorties totalling 128 flying hours. This represents a utilisation of just five hours per day. In that time the Porter carried 22,000lb of general freight, 41 drums of fuel and 50 passengers. After the completion of the operation, the aircraft was again disassembled, hoisted on board the MV *Nella Dan* and departed for Melbourne on March 3.

Following an evaluation of the Lockheed JetStar for use in the training of second officers, Eastern Airlines has added a Dash 8 to its fleet and will use it for charter and executive operations. The aircraft, called *WhisperStar* by Eastern, has a standard corporate flight deck; TWA, which has two JetStars for training, has modified the flight decks to resemble more closely those of its 727 fleet.



Letters

Feet on the Ground

SIR,—A. E. Bramson's eager pupil (see *Flight*, April 1) was either very lucky or exceptionally unenquiring, as he had at least managed to get some flying lessons. Anyone who has tried recently to get information about learning to fly from one of the commercial "clubs" will no doubt sympathise with the experiences of my wife and me.

Calling at or telephoning a club in answer to one of their advertisements, one is normally treated to the form of uninformed high-pressure salesmanship criticised in insurance and encyclopedia salesmen and practised by the less-than-scrupulous motoring schools when endeavouring to sell extra lessons. In passing, most driving school cars are at least clean and presentable, which is more than can be said for the majority of club aircraft.

The alternative response, no less disheartening, goes something like this: "I would like to talk to someone about learning to fly." "Yes, sir, 40-hour course? . . . Member of club for some period before flying in club aircraft. . . . So much an hour. . . . Ten per cent reduction for block booking. . . . Here are the forms. . . . Send them back when you make your mind up."

"But about licences and —?"

"Excuse me, phone."

"But, er —?"

"Hang on, must see this pupil."

"But —?"

"Look, can't you see I'm busy." We depart, our determination to fly deflated.

These experiences are not confined to one club but are the attitudes we have met with at three well known airfields and numerous better known clubs.

How anyone, no matter how keen to fly, can place any confidence in the training offered by organisations whose front offices are run in this way I do not know. Nor do I doubt the validity of Mr Bramson's spirited indictment. Having put together all the relevant information which we have been able to glean, my wife and I are convinced that restrictions on the growth of private flying in this country are more attributable to the amateurism and inefficiency within the movement itself than to petty officialdom.

I feel that it is a disgrace to the private flying movement that this letter has come to be written

Jay Sherlock of Fremont, Calif. has sent us this photograph of ex-RAAF Vampire T.35 taken at Oakland, Calif. Three of the aircraft were shipped over to be refurbished by Aero Specialties. Perhaps a reader knows where they were bound when they flew out



and suggest that the commercial arm of the movement should, if it is to prosper, organise itself to ensure that prospective pilots are not discouraged, as we have almost been, and that, once he or she is enrolled, all possible efforts are directed towards proper training.

Richmond, Surrey

C. I. THOMPSON

Clouding the Issue?

SIR,—Bravo Roger Bacon! Overcoming all obstacles and lack of copy he has, yet again, fearlessly and non-attributively taken another swipe in the general direction of Balpa and its naughty pilots.

Carry on the good work, Uncle Roger, and ignore any rumours of Balpa technical symposia or other voluntary exchanges of ideas and advice with the industry, worldwide. If anyone tries to tell you that together with the rest of the British piloting fraternity its members are as skilled and professionally well thought of as any, take no notice.

Facts would only cloud the issue. Whatever it is.

Crowthorne, Berks

C. J. FORD

The First Million

SIR,—The article "Insurers Cope with 747" in your issue of March 25 (page 404) states that no airliner has flown an initial million hours without loss. However, in the same issue (page 410) under the heading "Boeing Safety Record" it can be seen that the 737 had flown 359 million miles up to the end of 1970. The actual flying time must surely be approaching, or even have exceeded, the million-hours mark by now and therefore the first statement may be incorrect. This is assuming that no 737 has been lost in a non-fatal accident.

Falkirk, Stirlingshire

N. SWIERKLANSKI

For ASC Read A&AEE

SIR,—Reading your account of the "Boscombe Occasion" in *Flight* for April 1, I note that you attribute the ULLA drop to an ASC Hercules. The aircraft used was XV178 which is based at A&AEE and was operated on March 19, as on all our ULLA work, by A&AEE personnel, both Service and civilian. Thanks, nevertheless, for the splendid coverage you gave to our 50 years of aeroplane and armament testing.

Salisbury, Wilts

T. HEFFERNAN,

A&AEE Boscombe Down

First Night Flight?

SIR,—In his article relating to 50 years of test flying at Upavon, Martlesham and Boscombe, Rex King states that according to Service tradition the first night flight in Britain was made at Upavon, which RFC station was established in June 1912.

This claim is unfounded because the first night flight carried out in this country with an aeroplane was completed by my late friend Claude Grahame-White when he was competing with Louis Paulhan in the London-Manchester race on April 27-28, 1910. He had landed on the evening of April 27 at Ashton Road near Roade and 6 miles from Wolverhampton with the intention of resuming his flight at dawn. But he changed his mind and resolved to press on when the Moon was rising. Hastily lamps were arranged around the field and enthusiastic motorists

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

positioned their cars so that their headlights might assist him during the take-off. Within seconds of becoming airborne he managed to clear the tops of some trees by a few feet and then followed the railway and headed for Lichfield, where Paulhan had landed. Unfortunately the wind and rain made conditions so bad that Claude was forced to land and abandon his gallant effort. Those of us who saw him and the great Paulhan making their way in that exciting contest of long ago remember the occasion very clearly.

London N10

GRENVILLE MANTON

Log-book Prayer Answered?

SIR,—With reference to Mr R. A. Douglas's complaints regarding his new pilot's log book (Letters, April 1), may we draw his attention to the fact that our clients, Airtour Products, produce a commercial pilot's log book which we think he will find entirely satisfactory. It is less than half the price of the one he found in the Government Bookshop.

Buckhurst Hill, Essex

L. H. R. ARCHER,
Pressair

IN BRIEF

Leslie Hunt of Leigh-on-Sea, Essex, writes saying that on page 422 of *Flight* for March 25, in "the magnificent article on the RAAF," we should not forget that Air Cdre Hughie Edwards VC was in fact the second Australian Victoria Cross winner. Born in Western Australia, he transferred from the RAAF to the RAF before World War Two.

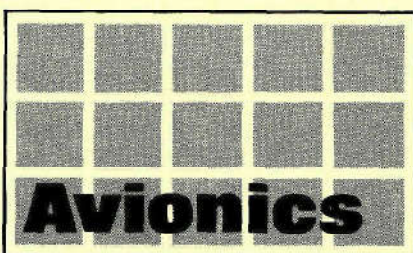
The 26th annual reunion of the Headquarters Bomber Command Association of Officers is being held at Headquarters Strike Command, Royal Air Force, High Wycombe, Bucks, on Saturday, June 5. If any member has not yet received details, these can be obtained by applying to the Hon Sec of the association, Lime Tree Cottage, West Street, Marlow-on-Thames, Bucks.

Mr E. B. Morgan, technical librarian of BAC Weybridge Division, writes querying the date applied to the Vickers Valentia in the Straight and Level photograph, *Flight*, February 4. K8850 was delivered to No 2 Aircraft Storage Unit on April 8, 1936, and

to the Electrical and Wireless School at Cranwell on February 24, 1937, so Mr Morgan feels that 1936 is the wrong date or the aircraft was flying from 2 ASU, which he doubts. Have readers any ideas?

DIARY

- Apr 21** RAeS Coventry Branch: annual general meeting and film show.
- Apr 21** RAeS Christchurch Branch: annual general meeting and film evening; 8 p.m., Anglo-Swiss Hotel, Gervis Road, Bournemouth.
- Apr 21** RAeS Chester Branch: Main Society lecture, "The Case for Stol" by E. E. Marshall; 7.30 p.m., Lecture Theatre, Grosvenor Museum, Chester.
- Apr 21** The Institute of Navigation: joint meeting with the RAF Specialist Navigation and GD Aero-Systems Course Association, "The Application of Low-light Television to Navigation"; 5 p.m., Royal Geographical Society.
- Apr 21** RAeS Astronautics and Guided Flight Section: all-day symposium, "International Collaboration in the Next Generation of World Space Projects"; 10 p.m., Lecture Theatre, 4 Hamilton Place, London W1.
- Apr 21-23** International Aviation Snow Symposium; Allentown, Pa.
- Apr 22** RAeS Belfast Branch: annual general meeting; 7 p.m., Short Supervisors Club, Belmont Road, Belfast.
- Apr 22** RAeS Gloucester & Cheltenham Branch: AGM and film show; 7.30 p.m., The Cinema, Dowty Group, Arle Court, Cheltenham.
- Apr 22** RAeS: 24th Louis Bleriot Lecture, "Piloting Techniques and Flying Qualities of the next Generation of Aircraft" by J. C. L. Wanner; 5.30 p.m. for 6 p.m., Service Technique Aeronautique, France.
- Apr 22** Institute of Mechanical Engineers: symposium, "Rapid-transit Vehicles for City Service"; 1 Birdcage Walk, London SW1 (registration is requested).
- Apr 24-May 2** 2nd International Light Aircraft Salon: Palais de Beau-lieu, Lausanne, Switzerland.
- Apr 25-28** Aerospace Medical Association: 42nd annual conference; Houston, Texas, USA.
- Apr 25-30** Engineering Foundation: conference, "Control of Quality in Construction"; Asilomar Conference Grounds, Pacific Grove, California.
- Apr 26** RAeS Derby Branch: "Pursuit of the Ultimate Design in Modern Gliders" by F. G. Irving; 5.30 p.m., R-R Huck-nall, Derbs.
- Apr 26** RAeS Air Law Group: "Legal Aspects of International Co-operation on Aircraft Design and Production" by C. B. White & W. B. Jenkins; 6 p.m., Lecture Theatre, 4 Hamilton Place, London W1 (preceded by AGM at 5.30 p.m.).
- Apr 26-29** FAA: 3rd Government/Industry National Aviation System Planning Review Conference; Twin Bridges Marriott Hotel, Washington, D.C.



By T. M. B. WRIGHT

ELSEWHERE IN THIS ISSUE are listed all the radio navigation aids which are available for civil aviation use. Of these perhaps the least well known is Omega, for although it has been in marine use for some years, the aviation version is still in the experimental stage.

Omega, which is in the 10kHz-14kHz VLF (very low frequency) band, has been developed by the US Navy since 1958 to take advantage of the low

attenuation rate and stable phase velocity of very-low-frequency signals. With ranges of 6,000-8,000 miles, eight transmitters will cover the Earth by 1972-73. At the present time, four transmitters are operating at reduced power, to cover the northern half of the western hemisphere.

Among the leading pioneers of the airborne equipment is the Canadian Marconi Company. System studies and an experimental programme have also been undertaken by RAE, who will be gaining further data from flight trials (due to take place next month) in which a version of the Canadian company's CMA-719 receiver will be used.

This measures the phase of 10·2kHz, 13·6kHz and 11·333kHz signals. The basic measurement is a 10·2kHz phase difference "land," with an eight-mile ambiguity (repeat cycle) which is in turn divided into 100 centilanes. The 13·6kHz and 11·333kHz signals are used to resolve the ambiguity to 72 miles. Signal loss for more than 36 miles is not expected in the final Omega transmitter transfiguration, but,

in such a case, the dead-reckoning input is used to eliminate loss of lane count. In normal operation the dead-reckoning input is used to eliminate dynamic error of the phase-locked loops.

The CMA-719 performs simultaneous phase tracking and signal-to-noise ratio measurement on the three Omega frequencies, three-frequency lane resolution, cross-correlator synchronisation, and automatic diurnal phase variation correction. For high-performance aircraft installation a computer-switched orthogonal ferrite loop antenna is used, though for installations where precipitation static is not expected a wire or loop antenna may be substituted. Airborne equipment includes a 16-bit, 4K, 2 microsec general-purpose airborne mini-computer to provide the software signal-processing functions.

The company claims that automatic airborne Omega receivers offer, for the first time, an earth-referenced navigation aid which will operate in the same manner to give lat/long output anywhere in the world.



Crime and security at British airports

A GREAT DEAL has been talked and written about the alleged lack of security at major international airports. Stories highlighting individual losses of cargo and valuables have discussed organised crime of Mafia proportions, criticised the supposed easy-going methods of protection and policing and generally castigated authorities for doing too little. What is the truth?

Worldwide, the truth is difficult to discover, but in Britain it can be expressed in simple and direct terms. In 1969 a total of £482,201 worth of property was known to have been stolen at Gatwick, Heathrow, Prestwick and Stansted, the four airports run by the British Airports Authority. But, of this figure, nearly £227,000 worth was recovered and 330 people were known to have been involved. A quarter of a million net loss is very small when the cargo turnover of Heathrow alone is taken into account—over £1,500 million in 1969. In addition to the value of freight there are countless millions in currency, travellers' cheques and personal valuables carried through the airport by passengers every year.

Helping to keep losses to a minimum with detection and recovery at a maximum is the British Airports Authority Constabulary. Under its Chief Constable, Mr W. Ronnie, this independent law-enforcement body with an average age of 33 is one of the youngest in Britain. It has to be dedicated to its task because within its airport boundaries almost every crime perpetrated in a large city is undertaken at some time. It must be particularly alert, too, because the population it tries to control and protect is one that constantly moves. In 1969 more than 50 million passengers and visitors ebbed and flowed through Heathrow, in addition to its town-sized working population of 48,000.

What, first of all, is the role of an independent police force at British airports? Its function is similar to that of any police force: the maintenance of law and order in public places and the protection of public property. The

Cargo is sometimes vulnerable in its course through an airport, above, and airport police check for weak spots in the airline systems

BAA Constabulary does not attempt directly to police the property of airport tenants any more than a civil police force patrols ratepayers' home or factory premises. Companies trading on airports are expected to look after themselves. When once their private guard is breached and property stolen or crime committed on their premises it is then the task of the police, once notified, to find those responsible. Their level of success is encouragingly high.

A big airport with its constant flow of traffic represents only one focal point of people's activities. Visitors leave the airport to go about their business, passengers disperse along air routes, to hotels and to their homes. Criminals follow a similar pattern of dispersal. For this reason airport police cannot operate in an aeronautical vacuum. They must work with, and rely on, the assistance of colleagues in other police forces and crime squads working in regions often remote from the airports.

Several years ago at Heathrow, for example, the CID branch of the BAA Constabulary formed a joint crime squad with the Metropolitan Police, a move which has paid handsome dividends. A criminal now knows that he is no longer safe once over the airport fence. The squad's highly trained members have helped to cut airport crime substantially. Their list of victories includes the breaking-up of dangerous gangs, the regular seizure of illicit drugs, tracking down of forgers and mail thieves, and more besides. Just over a year ago one Heathrow warehouse robbery netted thieves £185,000 worth of goods. But not for long. A large proportion of the property, £135,000 worth, was recovered and four people convicted. This particularly encouraging example of co-operation between police forces involved a number of the BAA Constabulary's Criminal Investigation Department. A minute knowledge of their own territory and the people working in it helped to start a trail that led to the thieves.

Not only do airports provide a variety of work for their police in an unusual environment but the BAA Constabulary has a number of compensations not normally found in civil police forces. Through the airport gateways come the rich, the famous, the infamous, people of influence and those who think that they ought to have influence from



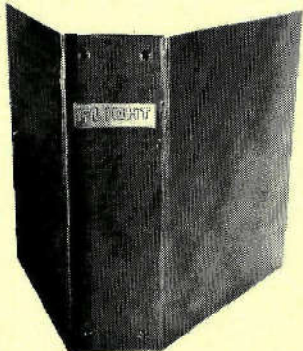
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Could you handle a job this size?

The giant jets are here—bringing a new challenge to the airport police. Anything can happen in a great international airport where millions of travellers of all nationalities are passing through, day and night. As a Police Constable in the BAA Constabulary, you'll have a varied life and a demanding one—round-the-clock vigilance for lawbreakers, moment-to-moment readiness for emergencies. It's a great job—and for a young man especially, it's a highly rewarding one, with the emphasis on expansion as air travel leaps forward into the age of the jumbo jet.

There are immediate vacancies at Heathrow for Police Constables in the

BRITISH AIRPORTS AUTHORITY CONSTABULARY

You have to be between 19-35, at least 5' 8" in height, physically fit and with good hearing and eyesight. You need plenty of common sense, a good education and the ability to express yourself clearly and concisely. Even at 19 you will earn at least £1,200 and further increases are currently under review. Uniform is free; there are regular pay increases and good opportunities for promotion to senior ranks. The BAA Constabulary is very much the young man's force. Assistance in obtaining mortgages may be given to suitable applicants.

Please write, telling us about your career to date, to

The Chief Constable,
BAA Constabulary HQ (FL),
Heathrow Airport,
Hounslow, Middlesex.



British Airports Authority



S22a
FLIGHT International,
15 April 1971

CRIME AND SECURITY AT BRITISH AIRPORTS . . .

BAA Police dog Rusty, far left, trained to scent out drugs hidden in imported cargo, searches an air consignment from Italy. Left, a special responsibility of BAA's policewomen is the welfare of young people

almost every nation in the world. Members of the Constabulary must be ready to deal with any one of them at any time. Last year, for example, they made arrangements for more than 1,000 arrivals and departures of the Royal Family, foreign royalty, premiers, ministers, governors, ambassadors, high commissioners and heads of armed forces. These, in Foreign Office terms, are the true VIPs.

Close contact with a particularly articulate section of the public puts a special responsibility on the airport police. They have an international as well as a national image to maintain. For this reason, among others, they are encouraged, with extra pay, to reach a speaking proficiency in foreign languages. One detective at Heathrow, for example, is fluent in Arabic, Italian and French.

Although it has no direct bearing on their work members of the force are encouraged to learn to fly. Half the training costs are paid by the BAA. Constable Robert Donaldson, 22, stationed at Heathrow, is at the moment taking a Private Pilot's Licence. Opportunities to travel abroad in connection with crime investigation come up from time to time and airlines willingly offer facilities to help these inquiries.

Small wonder, therefore, that the BAA Constabulary has little difficulty in finding the right calibre of men and women. In 1969 it received 1,418 enquiries from which well over 400 formal applications were made. The Constabulary is now looking for another 72 men to bring its total strength up to nearly 400. Complement is directly related to commercial activities at BAA airports. In December 1966 the strength was 201; nearly four years later it had risen to 326. Twenty-eight of these were women with a special responsibility for juveniles, women and children in addition to their normal police work. It was the women's police section which recently dealt with the widely publicised abortion racket at Heathrow.

Early recruitment

But Constabulary recruitment has not always been easy. When formed on April 1, 1966, vesting day of the British Airports Authority, the attractions of civil police forces were much greater and the job of finding the right people was, in consequence, very difficult.

The new Constabulary was formed round a nucleus of Civil Aviation Police but it was immediately obvious that a number of important factors needed putting right if the organisation was to perform its duties effectively and become a credit to the young authority. Chief Constable Ronnie, with the support of BAA's board, instituted a series of changes and reforms, designed to improve the status of the force and to provide all the ingredients for maintaining, at a high level, the morale and self-respect of its members.

Mr Pat Bailey, BAA's director of personnel, who is responsible to the board for the activities of the Constabulary, said recently to *Flight* about the reforms, "We wanted to change the old image, to make the new Constabulary part of a plan to establish an authority known for its efficiency and service. Pay and conditions were raised to the levels of civil police forces. To ensure that our constabulary was maintained at a common standard with the national police, we arranged for most of our basic training to be undertaken at the normal Home Office district training

centres and for our Constabulary to be inspected regularly by Her Majesty's Inspectors of Constabulary.

"We've come a long way in four short years and it shows in our recruiting. Because of the special attractions we offer, our high professional standards and rapid rate of expansion, over half of our officers have joined in the past four years. As you can imagine, the opportunities for promotions that this offers are very good. We believe that anyone recruited today capable of carrying three stripes will get them within five years. After that it's up to him. Our policy is to promote from within as far as possible and our restructuring of the Constabulary has been designed to provide good long-term career prospects."

During their career members of the force like to be active in their main task. The Constabulary aims to keep men from spending too much time at desks on necessary but sometimes tedious routines. A report form, for example, has been designed along O&M lines. Much of the subject matter requires only a tick in an appropriate box, although that most important piece of evidence, the statement, must still be prepared in full. But even here there is now a secretarial pool available to help. Filing of information has been reformed and access to it, through an efficient card index system, brought up to date. Detectives are issued with Philips Pocket Memo portable tape recorders for on-the-spot note taking, from which they can prepare reports later.

Efficient use of manpower, made possible by measures like these, is more than necessary when sudden strains are thrown on the Constabulary. A major aircraft accident, for example, can tax resources to their limits. Yet the airport police are hardly ever seen at the accident. Their role is to ensure that emergency services can reach the mishap without loss of time, and that back-up services are marshalled at rendezvous points and led quickly to the scene when needed. The purpose of this police organisation is to prevent sightseers and waves of vehicles driving haphazardly all over the airport, blocking the roads, stopping flying and generally bringing the airport to a halt. Major duty of the police is to see that the airport continues to function as normally as possible.

In another move to increase manpower efficiency, BAA is considering the use of traffic wardens. Visitors to airports are often confused by their unusual environment and a lot of police time is spent helping them to follow the airport regulations. A special traffic group would help enormously.

With reports of Mafia-sized crime at New York airports, the question arises as to whether a relatively small force like the BAA Constabulary would be able to deal with a well organised criminal syndicate. BAA's Constabulary feels certain of its ability to do so especially as there is at Heathrow a close association with the huge Metropolitan Police Force and excellent co-operation also exists with the local police force at the BAA's other three airports. In general terms, crimes at the airports are mostly ones of opportunity and seldom show evidence of central organisation.

A working relationship between the various police forces is the main key to the containment of crime at BAA airports. Britain's police forces are acknowledged to be the best in the world. As a small but specialised group, the BAA Constabulary can justifiably feel that its skills match the size of the task it faces. ■

INDUSTRY International

Products

Company News

Dunlop in the MRCA Dunlop Aviation Division, Coventry, has been selected by Panavia Aircraft GmbH, Munich, to supply tyres, wheels, brakes and Mark V electrical anti-skid equipment for the MRCA.

The present programme calls for seven prototype and nine pre-production aircraft with an estimated total of 1,000 production aircraft. The first flight of the aircraft is due in September 1973, and in-service date is scheduled for March 1977.

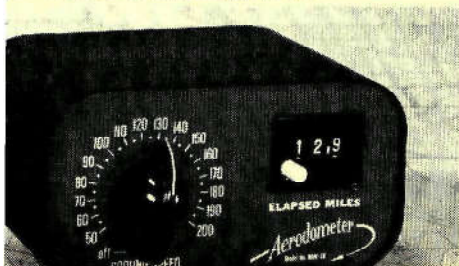
New ARINC Net? Construction of a \$257 million (£107 million) nationwide micro-wave-coaxial cable communications system for the air transport industry is being considered by Aeronaical Radio Inc, as a replacement for costly leased private-line circuitry, according to Mr John S. Anderson, chairman of the board of the industry's communications company.

Outlining the plans for the proposed network at the annual meeting of stockholders, Mr Anderson said: "The system is designed as a possible alternative to the present Arinc Private Line Intercity Network (PLIN) which depends on circuitry leased from the common carriers." He noted that "with just two tariff amendments the cost of leasing the present private line system doubled between the period September 1968 - February 1970 and now costs about \$60 million (£25 million) per year. Such tariff increases, coupled with the industry's estimated future inter-city communications requirements, make it imperative that alternatives be considered," he added.

The new network is scaled to a system capacity three times that of the existing one to meet anticipated requirements at a total estimated annual cost of \$78.9 million (£33 million), including end distribution cost and capital recovery.

The proposed plan provides for a

A low-cost portable mileage indicator, known as the Aerodometer, for use by commercial as well as private and student pilots, is now being distributed throughout Europe by the newly formed Aviation Division of Rowlen & Co, York House, Empire Way, Wembley, Middx. The Aerodometer indicates miles flown from the last intersection or check-point, a digital read-out showing the distance in miles to one decimal place



WHO'S SELLING WHAT?

Hawker de Havilland has been awarded a contract by Boeing valued at £725,000 to supply the rudder and wing ribs for the Boeing 727-200 series. . . . **Rotax Aircraft Equipment Ltd** has received an export order to supply 150 aircraft sets including spares, of electrically heated wind-screens for the Dornier 28D Skyser-vant. . . . The Astek Division of **Lear Siegler Inc**, which combined its operations with LSI's Instrument Division recently, has received an initial contract for \$448,426 (£188,000) from McDonnell Douglas Corp to manufacture altitude indicators for the F-15. . . . **Honeywell's Aerospace Division** has been awarded a \$2 million (£845,000) Nasa contract for management and engineering support for its Centaur inertial guidance programme.

. . . The advanced Technology Division of **American Standard**, Monrovia, Calif, has been awarded a contract from Vereinigte Flugtechnische Werke to supply the pitot tubes for the VFW 614 short-range twin-jet transport. . . . **Pye Telecommunications Ltd** has received orders from five European countries totalling almost £150,000, including a Portuguese Air Force order for nearly 100 radio-telephone base stations worth about £30,000.

network of 784 microwave stations including 307 terminals with 102,941 voice channel ends. It would extend over 21,815 route miles with a total of more than 18 million voice channel miles.

The "blueprint" for the system was drawn up by Collins Radio Co following a detailed engineering study of Arinc's existing and projected inter-city communications requirements.

DC-10 Tracking by Laser A laser tracking system designed to monitor in-flight performance of aircraft during certification tests is being produced by Sylvania Electric Products Inc. The system, which can track aircraft up to 60,000ft, will evaluate avionic, aerodynamic, and acoustic performance of the DC-10.

In tests, a low-powered, infra-red laser beam from a mobile ground station "locks on" to a reflector mounted on the aircraft in flight. The reflected beam is picked up by sensing equipment in the tracker which determines precisely the speed, azimuth and elevation angles, and altitude of the aircraft.

Capable of 100 measurements per second, the system detects angular changes in the beam and provides results in digital form for direct read-out or storage on magnetic tape for computer processing.

Airwork Safety Award The Bambara Flight Safety Trophy has been awarded to the Fleet Requirements Unit, Airwork Services Ltd, by Vice-Admiral M. F. Fell, Flag Officer Naval Air Command.

The Fleet Requirements Unit was established in 1952 and since then has been engaged in flying trials and other fleet requirements with both Royal Navy and foreign ships around the shores of the United Kingdom. During its operations from Hurn, Hampshire, the unit has achieved more than 80,000 flying hours in ten types of both piston- and jet-engined RN aircraft.

At present, the unit operates with Hunters and Canberras for gunnery exercises in the Channel, towing Rushton targets manufactured by Flight Refuelling at Wimborne, Dorset.

Aviation Consultancy Mr Ronald Harker, who recently left Rolls-Royce after 45 years with the company, intends to keep in close touch with aviation activities and is available as a consultant. His address is 8 Trevor Street, London SW7 (tel 584 4725). He was a premium apprentice before joining the aero side of Rolls-Royce and became a company test pilot when the Hucknall flight test centre was first formed. As a member of 504 Sqn, Auxiliary Air Force, he served as a fighter pilot in the early part of the 1939-45 war, before returning to Rolls-Royce to continue test flying. After the war he became the company's representative in London, liaising with the Services, Ministries and industry.

PEOPLE AND POSTS

Mr Geoffrey R. Villiers has been made vice-president, aviation marketing, for the Chevron International Oil Co. Mr Rolland E. Sears has been appointed to be the company's managing director and regional manager in London.

Gp Capt Eric R. Madger (Retd), has joined Raytheon Overseas Ltd as manager for international systems sales in the London office.

Coutant Electronics have appointed Mr Derrick Taylor to the main board as sales director.

Mr Charles B. Husick has been named president and chief operating officer of the Avionics Division of Narco Scientific Industries Inc.

UP TO DATE WITH GRAVINER

"**W**E GOT A FIRE WARNING LIGHT in the engine on my side. . . . But they had shut down the engine and flooded it with Graviner. . . ." HRH Prince Philip demonstrating in an interview reproduced in *Flight* three years ago just how synonymous the name of the company has become with its product.

Graviner (Colnbrook) Ltd was formed in June 1964 as a joint subsidiary of Wilkinson Sword Ltd and the Graviner Manufacturing Co which had been founded in November 1933 to design and develop fire-protection equipment for aircraft. Wilkinson Sword first undertook manufacture of Graviner fire protection equipment in 1936 and the two companies have been closely linked ever since.

By 1939 the demand for the Graviner airborne fire-protection system for military aircraft had increased to a point where the orders covered several thousand sets of equipment. When war became imminent an inter-company agreement between Graviner Manufacturing and Wilkinson Sword was signed by which Wilkinson became entirely responsible for manufacture of the equipment and Graviner for its design and development, sales and technical service to customers. The Poyle Mill site at Colnbrook, tucked under the take-off path from runway 28L at Heathrow, was acquired towards the end of 1939.

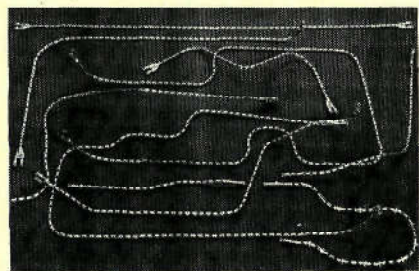
In the post-war years the company's activities steadily expanded and in 1964 it was decided to merge the Graviner and Wilkinson fire-protection equipment interests into a single company. As Graviner (Colnbrook) Ltd, it became one of the Wilkinson Sword Group with Wilkinson Sword having a two-thirds holding and Graviner Manufacturing one-third.

The Aerospace and Vehicles Division is one of four in the company and accounts for upwards of 70 per cent of business. Products fall under three main headings: fire and overheat detection, fire extinguishing and crash fire protection. The first is of greatest importance, though the second provides, of course, a continuing production and recharging line. The gravity inertia switches of the third equipment gave the company its name.

Graviner's best known product on the detection side is almost certainly Firewire, a flexible element of which lengths are series-connected to form a continuous loop. The loop is connected to a control unit which signals a warning in the case of overheat or fire and cancels the warning when ambient temperature drops below the pre-set level. The element is then ready to detect any further rise in



Graviner fire and overheat protection systems are used in hovercraft as well as in aircraft. Above is the extinguisher system on an SR.N6. Below, armoured Firewire elements are shaped to suit individual cases



temperature and requires no manual resetting.

The element itself is made up of three layers: a stainless steel capillary sheath, a flexible semi-conductor glass-like material and a central electrode. To ensure that some points in the element are not more sensitive than others, the electrode must be absolutely central and so when the capillary is fitted the semi-conductor material is broken up inside and the whole element reheated and cooled again before testing (research, development and testing laboratories are all on site).

Flexibility of use as well as in the physical sense is the keynote of Firewire, which can be delivered in various lengths and thicknesses, and with or without an armoured shield. In order to improve the false warning qualities of the element, the Triple FD system, similar to standard Firewire, was developed some years ago and the company now claims that this will not false-warn or fail to operate even if

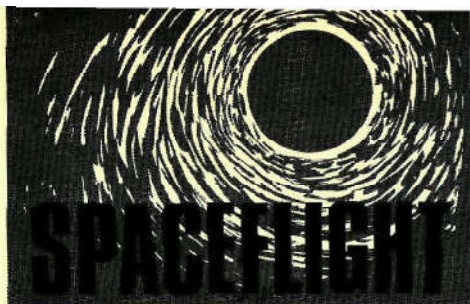
the loop is completely severed, provided that one end remains connected to the control unit and that the central electrode is not earthed. Developments of earlier Graviner point-source detectors can also be fitted into the loop at any point felt by the customer to warrant particular attention.

Triple FD is a good example of the company's development philosophy for, as with most things, the customer decides how much he can pay for a guaranteed piece of equipment. Research and development concentrates, therefore, on well proven techniques rather than on entirely new systems. Materials, particularly extinguishants like bromochlorodifluoromethane (BCF), change over the years, but Graviner pioneered simple, effective detection systems and succeeded in cornering a large section of the market by equally simple, effective developments.

This, of course, by no means entails the company dragging its feet over new ideas—a new ultra-violet flame-detection system is now available and is fitted to Concorde. This visual, rather than thermal, detection system has taken five years to develop and undoubtedly has much potential as powerplant operating temperatures continue to rise. Concorde is felt by Graviner to be perhaps the most important and interesting aircraft with its equipment fitted, mainly because, unlike others, it has practically every one of the range of aviation products aboard—from Firewire Triple FD to explosion protection (vent-pipe suppression) and UV sensing, via a specially designed BCF extinguishing system with spherical canisters.

In its 30-odd years, Graviner has generated a market for its products which is worldwide—it includes, for instance, the Boeing 747, a contract gained comparatively recently and one of considerable importance. Competition is strongest in the United States, but the advantages of quality, price and experience have a strong influence, the company feels. A number of overseas subsidiaries provide after-sales support. They are, chiefly, Deugra GmbH in Germany, Graviner Inc in the USA, Graviner (Australia) Pty, Graviner (Rofe Industries) Ltd in New Zealand, and Graviner SA in Paris, the last set up in 1967 specifically to promote use of the company's products on joint Anglo-French projects like Jaguar. Whereas the remainder of Europe appears to be fairly Graviner-conscious, the company is anxious that the French civil market be penetrated. With aircraft like the Mercure and the A-300B Airbus on the horizon, the strong impression is that now is the time.

With a worldwide market and organisation to match, new ideas, a smallish but skilled workforce of 750 and a highly respected and long established range of products, prospects for Graviner must seem as encouraging as their present leading position. C.M.G.



THE DRILL FOR HADLEY RILLE

In an attempt to obtain a core sample from a greater depth than those bored out on previous Moon missions, Apollo 15 astronauts will take an electric drill, which should enable a depth of 7ft, 2m to be reached. Powered by a battery-driven 0.4 h.p. motor, the drill should penetrate up to 5ft, 1.52m of soil, or 3in-5in, 8cm-13cm of basaltic rock, per minute. The stem will be built up from six 17in, 43cm sections and tipped with an open tungsten-carbide bit to admit lunar material. Drilling action will be a rotary-percussive motion, which will deliver 2,270 blows per minute while minimising torque and keeping operating temperatures low.

Two other holes each 10ft, 3m deep will be drilled for a heat-flow experiment using a selection of 22in, 56cm stem sections. The stems will provide a casing for the shafts into which highly sensitive electronic thermometers will be inserted to obtain information on both the outward flow of heat from the Moon and the thermal conductivity of the lunar material.

The Apollo 15 Alsep (Apollo Lunar Surface Experiment Package) will include, like its predecessors, a passive seismometer to measure meteoroid impacts and Moonquakes; a tri-axis magnetometer to measure the magnetic field; a solar wind spectrometer; a suprathermal ion detector to provide measurement of near-surface ions; and a cold cathode ionisation gauge which will obtain data on the density of neutral particles near the lunar surface. A lunar dust detector will be set up, as will a laser reflector, this one being larger than those left by Apollo 11 and 14.

Apollo 15 is scheduled for launch on July 25 to land on the Moon on July 30 near Hadley Rille, a gorge at the foot of the Apennine Mountains and about 465 miles, 750km north of the lunar equator. The first lunar roving vehicle will also be carried on this mission and, during the planned 67hr surface stay, commander David Scott and LM pilot James Irwin will make three excursions on the vehicle, leaving CM pilot Alfred Worden in the main spacecraft in lunar orbit.

COMSAT CREDIT

That commercial satellite communications has now fully established its place in the world is amply demonstrated by the significant increase in earnings for 1970 by the Communications Satellite Corporation (Comsat). Comsat's net income for last year amounted to \$17,501,000 compared with \$7,129,000 for 1969.

Operating revenues for 1970 reached \$69,598,000, an increase of 48 per cent over the \$47,034,000 received in 1969. Thus the net operating income for 1970 totalled \$10,480,000 compared with the 1969 figure of \$1,832,000 which was virtually the same as in 1968. This is attributed to an overall increase in use of the satellite system. By December 31, 1970, the equivalent of 2,139 full-time half-circuits were being leased to Comsat customers, compared with 1,435 at the end of 1969—an increase of 49.1 per cent. As a result, Comsat shareholders received the corporation's first dividend of 12½ cents per share for the last quarter of 1970, and the same is anticipated for the first of 1971.

Other features of 1970 were the launch of the last three Intelsat IIIs (including one failure), completion of the Bartlett Earth station, Talkeetna, Alaska, and the beginning of a new 97ft antenna at the Andover, Maine, Earth station.

SKYLAB RESCUE PLANNED

A method of rescuing astronauts from Skylab using an Apollo spacecraft and launcher has been formally approved by Nasa. After the launch of the last Skylab component, an extra Apollo command module and Saturn 1B booster will be prepared for launch. With a two-man crew, the third seat will remain available and two more couches will be fitted behind the crew seating in place of the storage lockers.

Skylab is to be placed in Earth orbit next year to provide experience and data toward setting up a permanent space station. It will be manned for one 28-day and two 56-day periods by groups of three astronauts. Under normal circumstances they will return to Earth in the Apollo spacecraft in which they arrived. Should anything prevent this, Skylab will be sufficiently provisioned to support survival for the four weeks it might take to effect the rescue.

Nasa concedes that the rescue system is limited to the most probable Skylab failure situations and could not be applied to a Moon mission. Nor could it be used in case of an explosion or fire, where the astronauts would be dependent on reaching their own Apollo ferry craft. The plan is expected to cost between \$45 million (£19 million) and \$50 million (£21 million).

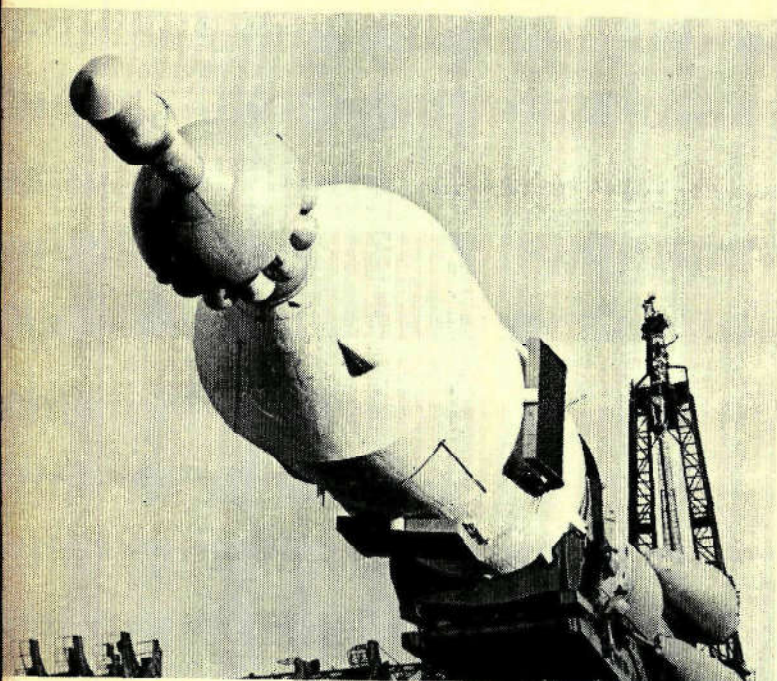
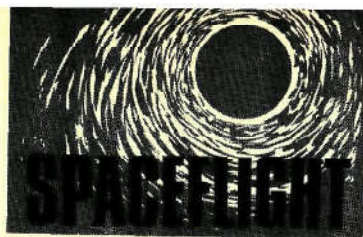
HEAO EXPERIMENT STUDIES

Seven-month study contracts have been placed with a number of US research establishments and universities to define the seven experiments to be carried on the first High Energy Astronomical Observatory (Heao-A). The studies, which together will cost nearly \$1.4 million (£580,000), will be for two cosmic-ray detectors, one gamma-ray experiment and four X-ray telescopes.

Two satellites, the second carrying five experiments, are now planned, although the programme has not yet received official blessing. The Grumman concept of the spacecraft was shown in *Flight* for October 29, 1970, and a conceptual description was given in *Flight*, November 19, 1970. A Titan IIID will be required to launch this 30ft x 9ft, 9m x 2.7m spacecraft into a 230-mile, 370km circular orbit. The seven experiments are expected to weigh about 12,500lb, 5,600kg, or more than half the 21,000lb, 9,525kg anticipated for the entire spacecraft. Heao-A is now planned for launch in mid-1975.

"Shagakhod" is the name given to a Soviet experimental planetary roving vehicle of which the high-stepping working model is shown below. Purportedly one of many follow-on concepts to Lunokhod 1, the design is intended to have greater manoeuvrability with a minimum use of power.





Mock-up of the Soyuz 9 launch escape tower is currently displayed (below) at the USSR Economic Achievements exhibition in Moscow (c.f. "Flight", February 11, page 214). The real thing is shown in position (above)



MORE EXPLORERS ORDERED

Three more Atmosphere Explorers (AE-C, -D and -E) are to be launched by Nasa in 1973, 1974 and 1975 to study the Earth's upper atmosphere. The satellites will be placed by Delta rockets into highly elliptical near-polar or near-equatorial orbits with perigees of 75 miles, 120km. This will enable detailed study of the thermosphere, lying 50-150 miles, 80km-240km above the Earth.

The spacecraft will be built by RCA under a \$12 million cost-plus-award contract made last month. A team of fifteen scientists was selected last February to conduct the appropriate investigations. Each spacecraft will measure about 54in, 137cm in diameter and 42in, 107cm in height and will weigh about 1,000lb, 450kg. They will be capable of automatic variation of orbital altitude—the first such use by Nasa for Earth studies—and will carry about 400lb, 180kg of hydrazine for this purpose.

EXPLORER 42 DISCOVERY

A new pulsating X-ray star has been detected by Nasa's Small Astronomy Satellite (SAS-A). The discovery was announced by Dr R. Giacconi, chief investigator for the satellite, at a recent meeting of the American Astronomical Society. The star, which has been designated Cygnus X-1, emits about 15 X-ray pulses per second and is located in the Cygnus, or Northern Cross, constellation. The only other known X-ray pulsar is NP-0532 in the Crab nebula, and it produces 30 pulses per second.

Cygnus X-1 is estimated to be only 10,000 years old and Dr Giacconi speculatively attributes the source to one of the enigmatic ultra-dense "black holes" rather than to a supernova explosion. To date the satellite has also confirmed a known Quasar as a source of X-rays as well as locating 13 other X-ray sources. Equipped with two X-ray collimators, the 315lb, 143kg satellite was launched into a 330-mile, 528km circular orbit from Italy's San Marco platform, off the coast of Kenya, on December 12 (*Flight*, December 17, 1970). Once in orbit it was named *Uhuru* and designated Explorer 42.

GRAND TOUR SCIENTISTS SELECTED

Nasa has selected 108 scientists from seven countries to help plan the Grand Tour mission, scheduled for the late 1970s. The scientists were selected from about 500 who submitted proposals for scientific experiments in response to a Nasa invitation last October.

The chosen 108 have been drawn from 36 US institutions as well as ten establishments in Canada, UK, Denmark, West Germany, France and Sweden. They have been divided into 13 groups, each covering different aspects of astronomical research.

Four more Cosmos The Soviet Union launched four more Cosmos-designated satellites in fairly rapid succession following the launch of *Cosmos 400* on March 19. *Cosmos 401*, launched on March 27 into a 134-mile×137-mile, 216km×220km orbit at 72.9°, is circling every 89.6min. *Cosmos 402* was placed in an orbit of 162 miles×173 miles, 261km×279km, inclined at 65° and with an 89.7min period, on April 1. The following day *Cosmos 403* was put in a similar orbit of 134 miles×155 miles, 216km×251km; inclination 81.4°; period 89min. On April 3 *Cosmos 404* was given a high orbit ranging from 503 miles to 626 miles, 811km to 1,009km, and was stated to have been the last in a particular programme of scientific research.

Erts evaluation The Chesapeake Bay area of the US East Coast, one of four test areas selected to evaluate the first Earth Resources Technology Satellite (*Erts-A*), was the subject of a three-day conference on remote sensing at Wallops Island last week. About 400 regional officials were invited in order to identify the primary environmental problems of the area which covers about 20,000 sq miles of Virginia, Maryland and Delaware. *Erts-A* is to be launched in spring next year.

CONCORDE FOR THE AIRLINES · PART ONE

COMMERCIAL PERFORMANCE

- Concorde will enter airline service in 1974 with a Paris - New York payload of 24,000lb, 10,900kg against winter headwinds and with full fuel reserves.
- A dispersion of about 4,000lb, 1,800kg in payload is being allowed at this stage by the manufacturers, so the worst case would result in a 20,000lb, 9,100kg payload and the best in a 28,000lb, 12,700kg figure.
- Minimum guaranteed payload is expected to be 20,000lb, 9,100kg on service entry, rising to 25,000lb, 11,350kg from the 41st aircraft which is due to be delivered in 1976 with improved engines.
- A mixed fleet of Concorde and subsonic jets should be more profitable for airlines than an all-subsonic fleet
- Return on investment for airlines from Concorde should be about 15-16 per cent.
- Concorde selling price will start at \$24 million without spares and \$30 million with spares.

CONJECTURE over Concorde performance has given way to facts from prototype trials, and these facts allow the manufacturers—the British Aircraft Corporation and Aérospatiale—to display total confidence in the ability of the production aircraft to meet its guarantees. The yardstick capability has always been a 25,000lb, 11,350kg payload between Paris and New York, non-stop, after about two years in service, which on current estimates should be in 1976. Every indication points to the fact that this payload will be achieved and, indeed, bettered.

As tests have progressed, the scatter in the estimates of the possible performance of production Concorde has steadily narrowed, allowing the economics to be defined within relatively close limits. But economics are inevitably dependent on variables and assumptions which await clarification primarily from decisions to be taken at Iata fares conferences. Iata has consistently dragged its feet over this matter, with the result that the airlines have no firm guidelines to follow on likely SST fare levels. Much also depends on subsonic fares policy when Concorde is in service, and of course on passenger reactions. If a new aircraft does not appeal to the passenger, or offer him the kind of service he wants, he will go elsewhere. But the appeal of Concorde lies in halved journey times, and historically speed has always had a major positive influence on travelling habits.

Data from the flight-test programme—more than 400hr of flying—was being prepared for analysis by the major airlines in March, ready for detailed contractual negotiations. The first of the 74 options held by 16 airlines are expected to be converted to orders this summer, although most carriers are adopting a sceptical negotiating stance.

BAC and Aérospatiale think the aircraft is now generally considered viable and a potential money-maker for the airlines, but sales are primarily dependent on airline acceptance of the manufacturers' contention that a mixed fleet of Concorde and subsonic aircraft will be more profitable than a purely subsonic fleet. Environmental considerations, particularly airport noise, are also major factors to be borne in mind.

The Governments are satisfied that the manufacturers' conclusions, derived from prototype performance and BAC/Aérospatiale assumptions, are valid. But, of course, the considerations facing the Governments are more complex. Concorde falls within the European political arena and embraces issues of national prestige and technological status. It also employs about 50,000 people at present, and this number could increase substantially when the aircraft is in production. But the primary consideration must be whether the airlines will make money from Concorde and whether they will order it. The anticipation in Government circles is that airlines will make profits from Concorde—the aeroplane would not be under continuing development if swingeing losses were expected.

Obviously a total recovery of the estimated £825 million

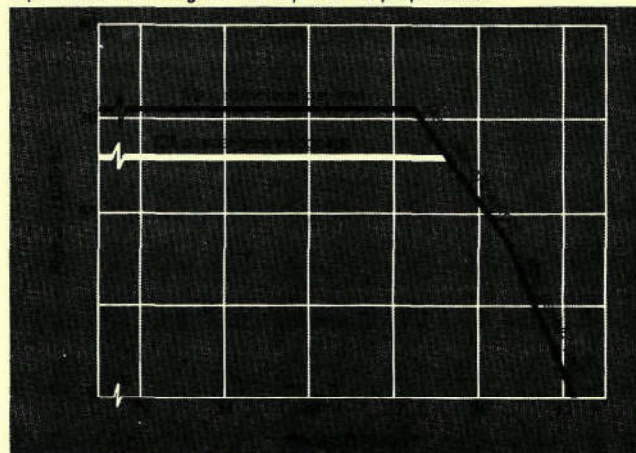
research and development bill is not in prospect. A realistic assessment will have to wait for sales to crystallize, but recoupment of up to about a third of the total has been mentioned in the House of Commons. Aérospatiale concedes that the average man in the Paris street is less aware of Concorde costs than his counterpart in London, but the aircraft appears to command a greater national pride in France.

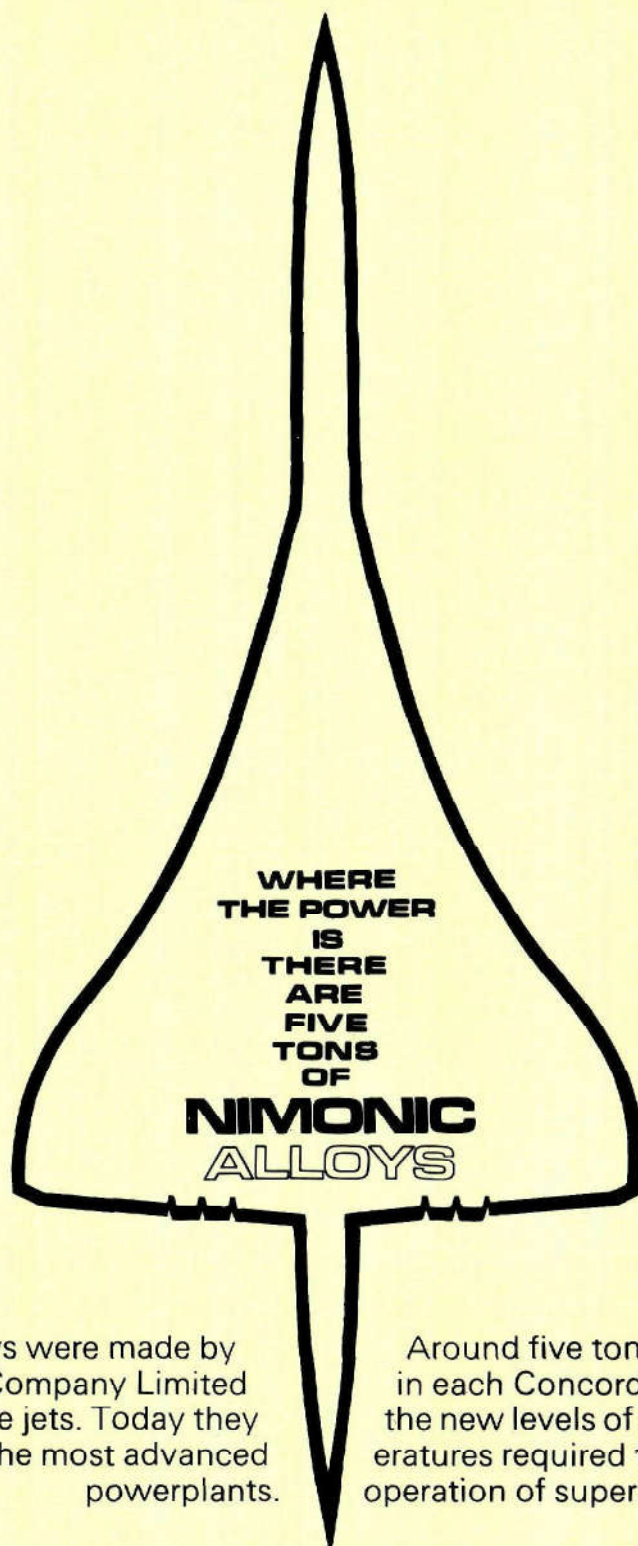
The basis of the guarantees made to the airlines on Concorde performance is the ability to carry a minimum 20,000lb, 9,100kg Paris-New York payload against winter headwinds on initial entry into service in 1974. Early in 1976, the guaranteed minimum payload is scheduled to rise to 25,000lb, 11,350kg, when the 41st production aircraft is due to enter airline service. Concorde should initially begin services with a 24,000, 10,900kg Paris-New York payload, although at present the manufacturers are allowing for a 4,000lb, 1,800kg dispersion in their predictions. So the worst assumption could give 20,000lb, 9,100kg and the best, the volume-limited payload of 28,000lb, 12,700kg. BOAC has assumed a payload of more than 23,000lb, 10,400kg in all its feasibility studies on all routes.

The 5,000lb, 2,270kg payload increase due in 1976 translates into 160-170 miles of range—bringing Washington, Detroit and Toronto within reach of London, and Frankfurt, Hamburg, Zürich and Copenhagen within range of New York. Declared usable fuel is 199,000lb, 88,500kg but Mr Pat Burgess, Concorde marketing director, is hopeful that supersonic trim requirements will be undemanding and allow some of the 7,000lb-worth of air space in the rear trim tank to be filled with fuel and thus further increase the range of the aircraft.

Profits derived by the airlines from a Concorde fleet

Payload-range of the first production Concorde, showing its estimated capabilities assuming the worst predicted performance





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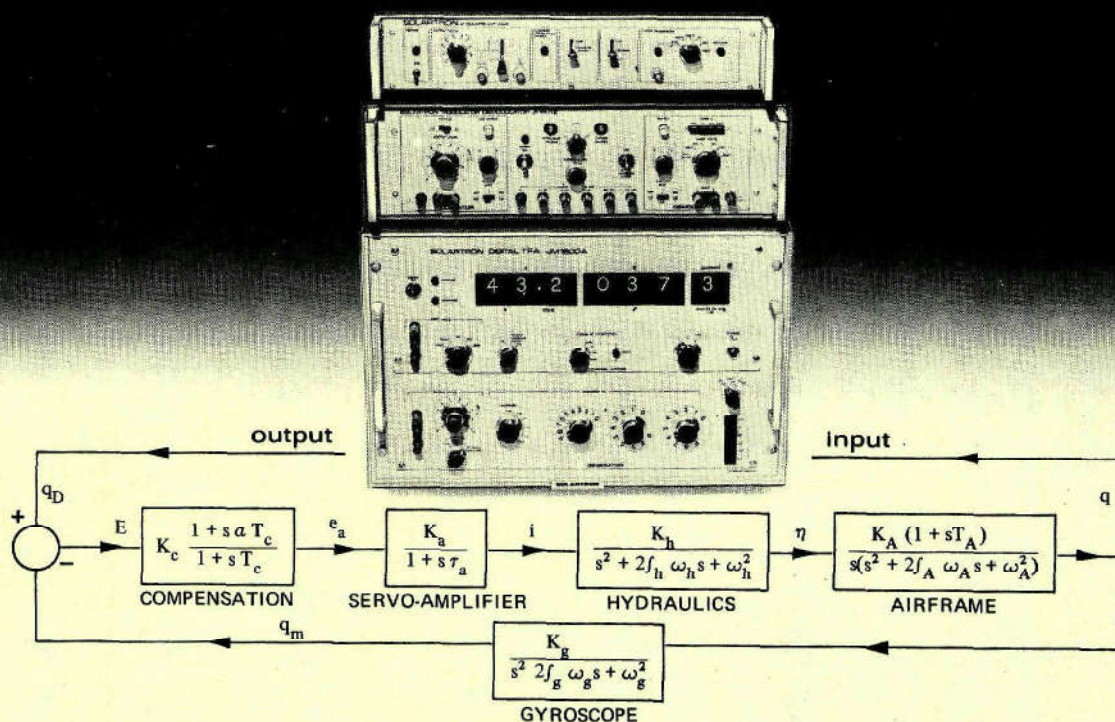
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Prototype 001 returns to Toulouse Saint Martin after a night flight in the test programme which is working towards certification of the airline Concorde early in 1974

COMMERCIAL PERFORMANCE...

will depend on rather more than the economic potential of the aircraft taken in isolation. Concorde will be introduced, not as a substitute for existing airline equipment, but as a complement to it. Operating economics of the aircraft are therefore bound up with the way it can be integrated with the wide-bodied jets which offer considerably lower seat-mile costs. The extent of the return on investment from a mixed subsonic and supersonic fleet will vary according to the type and number of seats fitted to and filled in each type of aircraft, fares policy, Concorde first costs (tentatively \$24 million plus) and, to a lesser degree, the period of its amortisation.

But exactly how Concorde will be operated is a decision for the airlines. It can be offered as a single-class vehicle commanding—for halved journey times—some kind of premium fare, or in various ratios of mixed classes at rates to match. This is a very complex matter but BAC and Aérospatiale are confident that any method of Concorde operation likely to appeal to the operators as sensible will also be profitable and practicable. A basic example is the single-class, premium or "superior" layout of about 110 seats. This demands from Concorde the ability to fly the North Atlantic non-stop with a 22,000lb, 10,000kg passenger payload plus mail. A mixed-class layout with a similar passenger load has also been proposed, but the 128-seat option has been used only as a comparison standard—the relatively restricted accommodation which results does not match the concept of superior-class accommodation.

The BAC argument is that an airline operating Concorde as a single-class vehicle, and with its subsonic jets carrying the economy-fare passengers at 55 per cent load factor, would, with only half its Concorde seats filled, begin to make more money with Concorde than without it. On a Concorde load factor of 60 per cent, the airline's net annual return on investment would be some three percentage points higher than with an all-subsonic fleet and when Concorde was 63 per cent full the return would be increased by about four points.

The manufacturers have had no need to revise their estimates in the light of flight-test results. As the British and French Governments received the preliminary document in mid-February summarising progress with the Concorde flight test programme, the time logged by the two prototypes was approaching 400hr in nearly 200 flights. It included more than 90hr of supersonic flight, a dozen of them being at Mach 2. From this information, and in particular from the Mach 2 results and those from flights under subsonic cruise conditions, the expected performance of the bigger production aircraft—fitted with more powerful Olympus engines and embodying an extended rear fuselage—has been calculated. The "read-across" to production aircraft performance has been simplified following some flying by 001 with nacelles sealed to a standard

approaching that of the production aircraft powerplants.

The results differ only marginally from predictions. In this respect Concorde has met with what BAC terms a "success unique in the annals of commercial aircraft flight development." Mr Brian Trubshaw, BAC director of flight operations, thinks the way the aircraft has come out on specification is due in no small part to the fact that right from the start each team had to justify and argue through its decisions with its counterpart on the other side of the Channel.

Both prototypes have shown impressive handling qualities, but the primary task has been the gathering and analysis of performance data which has shown very good correlation between the prototypes. A viable Mach 2 cruise is thus assured, but a good subsonic performance will also be necessary on many sectors where booms will be intolerable. A late drag rise is thus imperative, and it has been shown to come as high as Mach 0.96 on Concorde. The aircraft might also prove to be a viable transonic or low supersonic US coast-to-coast proposition, cruising at up to Mach 1.04, when the boom would be attenuated before reaching the ground. A 40min time saving could result, and it might be noted that the Convair 990 was sold in small but significant numbers on the basis of a 10min saving on that type of route. The technique would certainly make sense if the sector were part of a wider operation.

Concorde's maximum aerodynamically limited cruise speed is Mach 2.2, but the mission cruise will vary within the range of Mach 2 and Mach 2.2, according to the ambient temperature at cruising altitude. From an analysis of worldwide high-altitude temperatures it is estimated that at least 37 per cent of all Concorde missions will be flown at Mach 2.2 and at least 60 per cent at Mach 2.1 or above, although the structural temperature limit under ISA conditions restricts Concorde to Mach 2.05.

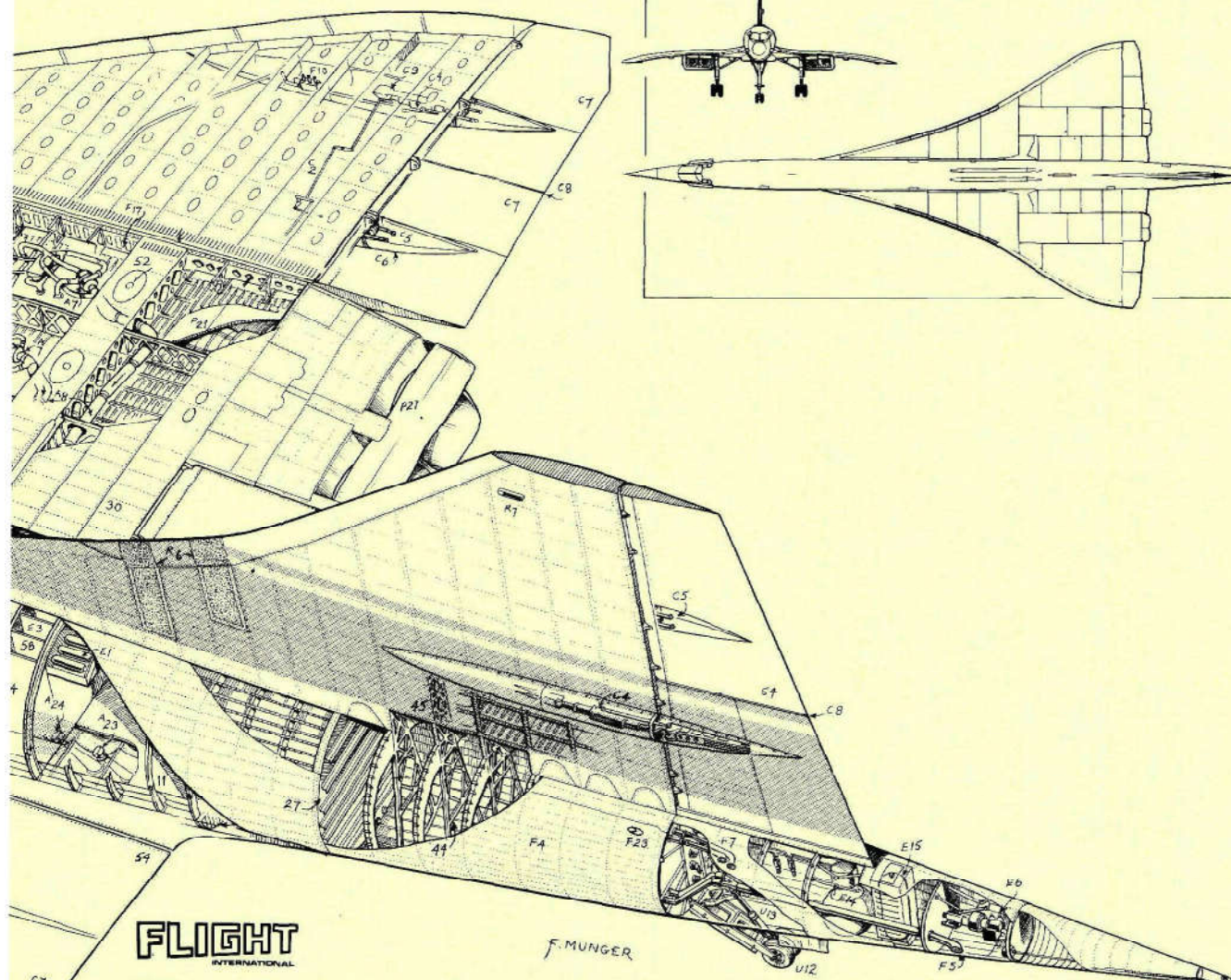
Draft contracts are in the possession of BOAC and Air France, while negotiations are under way primarily with Pan Am, TWA, JAL and Qantas together with some of the other option-holding airlines. But the industry is facing unprecedented short-term financial and equipment problems and the dilemma of over-capacity.

In the past, inflation and the increased capital costs of new aircraft have been more than absorbed by their greater productivity; the Boeing 747 may be three times as productive as a 707 but this potential benefit can only be realised if load factors remain reasonably high, at around 50 per cent to 60 per cent. If frequencies are to be maintained then a major traffic growth is necessary to keep the 747s running at profitable load factors. The airlines are thus faced again with the old over-capacity problem of 1960, but this time the problem is much worse and has accounted for the cut-back in 747 production to five a month, and the severe inroads into the 747 market made by the smaller TriStar and DC-10.

Load factors on 747s have been running just about on the 50 per cent mark during the first year of North Atlantic service, but the signs of impending frequency reductions are beginning to appear on US domestic services.

In 1960, the 707 represented not only a large increase in productivity but also a great improvement in journey times, which helped to initiate a significant increase in traffic. The over-capacity was thus quickly absorbed. But the wide-bodied jets present no improvement in journey times, and consequently the airlines have been faced with the problem of filling 747 seats through the only other measure available—reduced fares. In an environment of rapid inflation, fare reductions are an extremely delicate operation and the first attempt at the Caracas fares conference in November 1969 (when the basis of excursion fares was considerably broadened) had to be refined in September 1970 at Honolulu. BAC thinks the room for manoeuvre on fares, remembering that reduced fares mean reduced airline revenue yields, is insufficient, and the solution to the over-capacity problem will inevitably be a general fare increase, otherwise there is a strong possibility that some major carriers may go bankrupt.

PETER MIDDLETON


FLIGHT
INTERNATIONAL

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- P25** Nozzle-mounting spigots
P26 Pneumatic nozzle-actuator
P27 Combined secondary nozzle and reverser buckets
P28 Bucket-actuating screw-jacks
P29 Hydraulic motor
P30 Retractable silencer lobes ("spades")
P31 Silencer-lobe actuator and linkage
P32 Non-structural engine-access doors
P33 Oil tank

Radio and electronics

- R1** Radio and electronics racking
R2 Circuit-breaker panels
R3 Electrics bay
R4 Aft electronics bay (port and stbd)
R5 VHF 1 antenna
R6 HF slot antenna
R7 VOR antenna
R8 Electrics connectors

- R9** Electric conduits
R10 Cloud/collision radar

Undercarriage

- U1** Machined nose-gear mounting beams
U2 Nose-gear hinge
U3 Side braces
U4 Retraction jack (free-fall emergency lowering)
U5 Telescopic drag strut
U6 Rack and pinion steering motors $\pm 60^\circ$
U7 Nosewheel tyres: 31in x 10.75 in, 175 lb/sq in
U8 Mainwheel tyres: 45in x 15.75 in, 200 lb/sq in
U9 Provision in wheels for fan-cooling of brakes (upper wheel omitted for clarity)
U10 Bogie beam damper
U11 Pre-shortening mechanism
U12 Tail bumper, retractable (twin 14in wheels)
U13 Shock absorber
U14 Retraction jack

The production Concorde depicted in the cutaway drawing and three-view, top, differs from the prototypes as detailed in the table below. The aircraft features revised wing tips, a new transparent cockpit visor, a "sting" tail, and revised thrust reversers and silencers. It has a taller undercarriage and improved steel-rotor brakes for which Dunlop has the contract for the first three production aircraft. Tenders have been requested for lightweight beryllium or possibly carbon brakes. A single-class cabin (bottom left) would typically contain about 108-112 seats. A revised structure allows the cabin to be extended aft, to mid-way along the fin, on the production aircraft.

	Prototype	Production
Length	184ft 6in, 55.2m	204ft, 62.2m
Fuel	174,000lb, 79,000kg	206,400lb, 94,000kg
Take-off weight	326,000lb, 148,000kg	385,000lb, 174,300kg
Volumetric payload limit	23,600lb, 10,700kg	28,000lb, 12,700kg

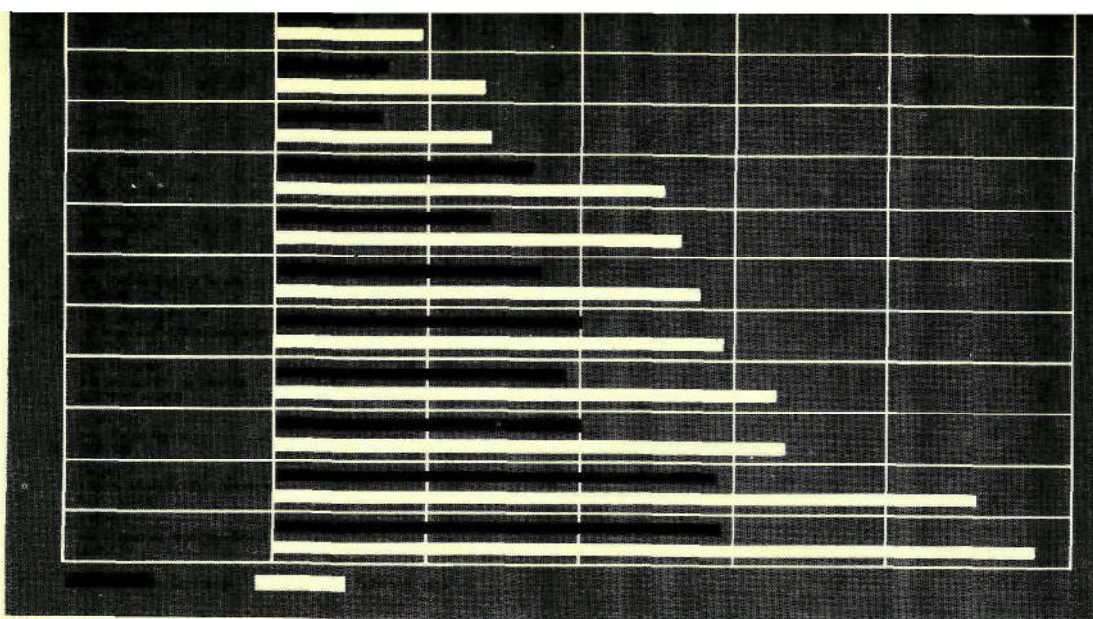


Table includes 45 min for transits. ★ Concorde only

Concorde supplies in abundance what the consumer has always wanted—time

AIRLINES AND ROUTES

SPURRED by this environment the airlines are examining in detail the profit potential of new aircraft, and particularly such a radical innovation as an SST. However, while the business market at which the aircraft is aimed has suffered less than the tourist sector, Concorde salesmen have been facing the attitude prevalent in many airlines that a decision to order, though desirable in the long term, may not be of immediate necessity. BOAC chairman Mr Keith Granville summed up much of the airline feeling last December when he said: "We want to take this step [going supersonic] with reasonable economy. . . . Provided the technical side goes right, we want to find ways to make Concorde a success." More recently he stated that BOAC's objective is to go supersonic as soon as possible, and that his airline was "working in a very positive way with BAC and the Government on the best way of doing so." BOAC, which has the first Concorde delivery position, has been very careful not to pour cold water over the project, but some planners within the corporation are known to have their reservations about the aircraft. The ultimate objective must be profit for the airline, although this is not the only consideration to be taken into account by BOAC and Air France. But other airlines are treading no such delicate political tightropes. Mr Burgess says negotiations with Air France and BOAC are going quite well.

Pan American is usually first in the field of international airlines to buy new equipment, but their president, Mr Najeab Halaby, has a £20 million 1970 loss on his hands and the 747 only began "shaking down" smoothly after a year in service. He told *Flight* during March, when other option-holders were also canvassed, that SSTs must prove under actual airline conditions for a "reasonable" time that they can operate safely, economically and in a socially acceptable manner. Mr Halaby continued, "BAC has not yet proposed specifications and guarantees for Concorde, pending more Mach 2 testing. We accordingly must continue our evaluation until we receive and study these guarantees." Pan American wants governments to establish realistic and uniform SST standards on airworthiness, noise and pollution. Airport noise is one area in which Mr Burgess finds difficulty in giving specific contractual guarantees, but is adamant that considerable progress has been made recently and that Concorde will be no worse than current (707-type) aircraft and will be better in some respects.

TWA has remained relatively tight-lipped on Concorde

as it nurses its £27 million loss for 1970 and its TriStar troubles. Mr Samuel Higginbottom, president of Eastern, has similar problems and was making no comment about his Concorde plans until resolution of "much more fundamental issues." Previously, Eastern had been considering the New York-San Juan and Mexico City routes, but has been conscious of the possible boom problem over the Caribbean islands. Braniff has yet to establish its route scheduling, but the long runs down to South America would be likely candidates for "early profitable operation." Likewise United is still studying the question but is thinking in terms of Hawaiian routes. Continental still needs to complete its detailed route analysis.

Route structures for BOAC would be based on London, with runs to Tokyo via Siberia together with a Johannesburg and Sydney operation following the initial services on the Atlantic. Air France managing director M Pierre Cot initially envisages using three Concorde on the Atlantic services, to be followed possibly by Paris-Tokyo, using 707s for the Paris-Moscow sector, on which supersonic flight could not be tolerated. His main concern is finding the finance. Pan American and Qantas have been thinking in terms of an early date for putting Concorde on the rapidly expanding and long-distance Pacific sectors where predictions of traffic expansion have run to 19 per cent and 17 per cent on the northern and southern routes respectively. American thinks its new Pacific licences might also find Concorde application.

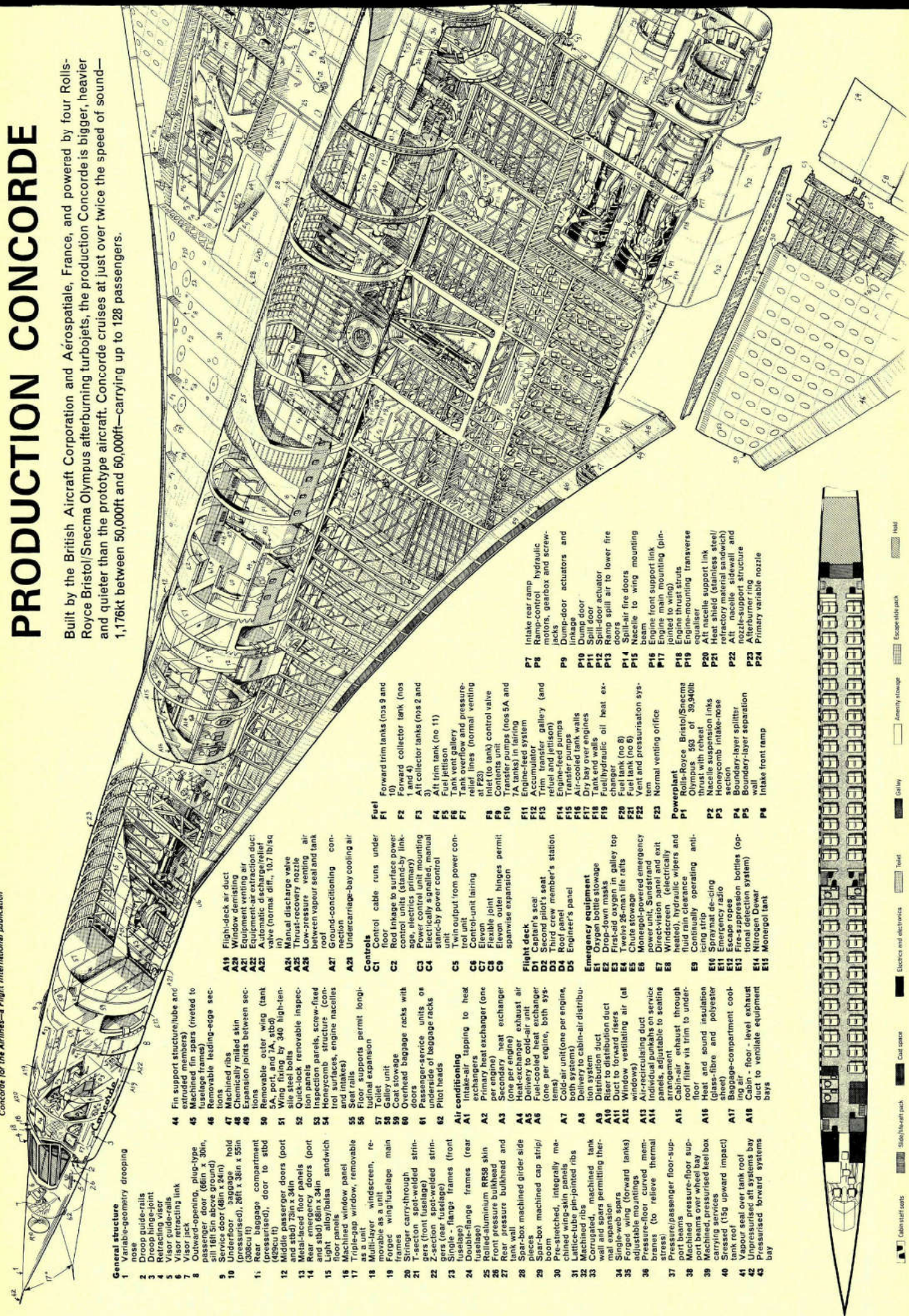
Initially the Atlantic is going to be the most popular route because of its high, business-orientated traffic density and the relatively short ranges involved, which will allow two round trips a day.

The United States eastern seaboard will form the nerve centre of Concorde operations in the mid-1970s.

But it could prove difficult to schedule regular services between London and Tokyo and Sydney in the early days when relatively few aircraft will be available. Europe to Tokyo over Siberia would be a tailor-made route for Concorde, but one suspects that sonic booms from the Tu-144 might fall on rather deaf ears than disruptions from the Anglo-French SST. The boom as such is now regarded as something of a red herring by the manufacturers, who base sales estimates of 250 aircraft by 1980 on the assumption that no boom will be permitted over populated areas. Nevertheless, the boom is the major constraint on the potential Concorde market. Most routes will be flown over water, but the problems arising from

PRODUCTION CONCORDE

Built by the British Aircraft Corporation and Aérospatiale, France, and powered by four Rolls-Royce Bristol/Snecma Olympus afterburning turbojets, the production Concorde is bigger, heavier and quieter than the prototype aircraft. Concorde cruises at just over twice the speed of sound—1,760kt between 50,000ft and 60,000ft—carrying up to 128 passengers.



General structure

- 1 Variable-geometry drooping nose
- 2 Droop guide-rails
- 3 Droop hinge-joint
- 4 Retracting visor
- 5 Visor guide-rails
- 6 Visor retraction linkage, plus-type passenger door (66in x 30in, sill 18in above ground)
- 7 Service door (48in x 24in) (pressurised), 28ft x 38in x 55in (300cu ft)
- 8 Underfloor baggage compartment (pressurised), door to stbd (480cu ft)
- 9 Middle passenger doors (port and stbd) 73in x 34in
- 10 Metal-faced floor panels (port and stbd) 68in x 34in
- 11 Light alloy/balsa sandwich floor panels
- 12 Machined window panel
- 13 Triple-gap window, removable as a unit
- 14 Multiple windscreen, reinforced wing/fuselage main frames
- 15 Stinger carry-through
- 16 T-section spot-welded stringers (front fuselage)
- 17 Z-section spot-welded stringers (rear fuselage)
- 18 Single- and flange frames (front fuselage)
- 19 Double-flange frames (rear fuselage)
- 20 Rolled aluminium RRS9 skin
- 21 Rear pressure bulkhead and tank wall
- 22 Spar-box machined girder side pieces
- 23 Spar-box machined cap strip/boom
- 24 Attached, integrally machined wing-skin panels
- 25 Lattice-tube pin-jointed ribs
- 26 Machined ribs
- 27 Corrugated, machined tank wall and spars permitting thermal expansion
- 28 Forged wing (forward tanks)
- 29 Pressure-floor curved members (to relieve thermal stresses)
- 30 Pressure/passenger floor-support beams over wheel bay
- 31 Stressed (150 upward impact) carrying supports
- 32 Machined pressure floor support beams over wheel bay
- 33 Vankor seal over tank roof
- 34 Unpressurised aft systems bay
- 35 Pressurised forward systems bay
- 36 Fin support structure (tube and end members)
- 37 Machined fin spars (riveted to fuselage frames)
- 38 Removable outer wing (tank 5A, port, and 1A, stbd)
- 39 Wing fixing by 340 high-tensile steel bolts
- 40 Thrust-recovery nozzle
- 41 Low-pressure venting air between vapour seal and tank roof
- 42 Ground-conditioning connection and intakes
- 43 Undercarriage-bay cooling air

- 44 Fin support structure (tube and end members)
- 45 Machined fin spars (riveted to fuselage frames)
- 46 Removable leading-edge sections
- 47 Chemically treated skin
- 48 Equipment air extraction ducts
- 49 Equipment air extraction duct valve (normal diff., 10.7 lb/sq in)
- 50 Thrust-recovery nozzle
- 51 Low-pressure venting air between vapour seal and tank roof
- 52 Ground-conditioning connection and intakes
- 53 Undercarriage-bay cooling air
- 54 Fuel
- 55 Forward trim tanks (nos 9 and 10)
- 56 Forward collector tank (nos 1 and 4)
- 57 Aft collector tanks (nos 2 and 3)
- 58 Aft trim tank (no 11)
- 59 Fuel jetison
- 60 Tank overflow and pressure-relief lines (normal venting at F23)
- 61 Inlet (to tank) control valve
- 62 Contents unit
- 63 Transfer pumps (nos 5A and 7)
- 64 Engine-lead system
- 65 Accumulator
- 66 Trim transfer gallery (and refuel and jetison)
- 67 Engine-lead pumps
- 68 Aft bay over engines
- 69 Fuel/hydraulic oil heat exchanger
- 70 Fuel tank (no 8)
- 71 Fuel tank (no 6)
- 72 Vent and pressurisation system
- 73 Normal venting orifice
- 74 Rolls-Royce Bristol/Snecma Olympus 593 Mk 2, 35,940lb thrust each
- 75 Nacelle suspension links
- 76 Honeycomb intake-noise section
- 77 Boundary-layer splitter
- 78 Boundary-layer separation
- 79 Wall
- 80 Nitrogen tank



- 1 Cabin staff seats
- 2 Stow/baggage pack
- 3 Cud space
- 4 Electric and electronics
- 5 Fuel
- 6 Galley
- 7 Assembly storage
- 8 Escape slide pack
- 9 Fuel

islands and Middle Eastern peninsulas might require individual negotiation.

Airlines have been reported as believing that the required load factor for viable commercial operations could be around 70 per cent on all routes—a level easily attainable on Concorde at entry into service. But competitive pressures might force the aircraft on to some of the less dense traffic routes where such loads might be less easily come by. Concorde, it appears, is not over-sized for the turn of the decade when such transfers could begin.

FLEETS AND FARES

TYPICAL CONCORDE MARKET PENETRATION (5,000 n.m. stage)

Ticket Type	Split %	Business ratio	Current fares £	Concorde time saving minus 10% (hr)	Typical Concorde penetration
First	10	300	842	3.40	10
Economy	25	70/25	260	—	8.5
Excursion	30	20/30	180	—	2.5
Group	35	0/100	140	—	—
					21.0%

A typical analysis of how Concorde could fit into the travelling structure if operated in a superior, single-class layout. The economic viability of the aircraft is dependent on the balance between the higher cost of supersonic fares and the attraction of reduced journey time for particular segments of the travelling public.

The British Aircraft Corporation and Aérospatiale make no secret of the fact that the massive improvements in journey times brought about by Concorde will have to be "bought" for the price of operating costs, but point out that civil aviation has grown and flourished by selling speed. If no surcharge were applied to the Concorde fare then the manufacturers have no doubt that all passengers would prefer to fly by Concorde. Such a policy, however, would result in unworkably high Concorde load factors, with consequent over-booking problems which would no doubt attract the attention of the consumers' lobby at the CAB.

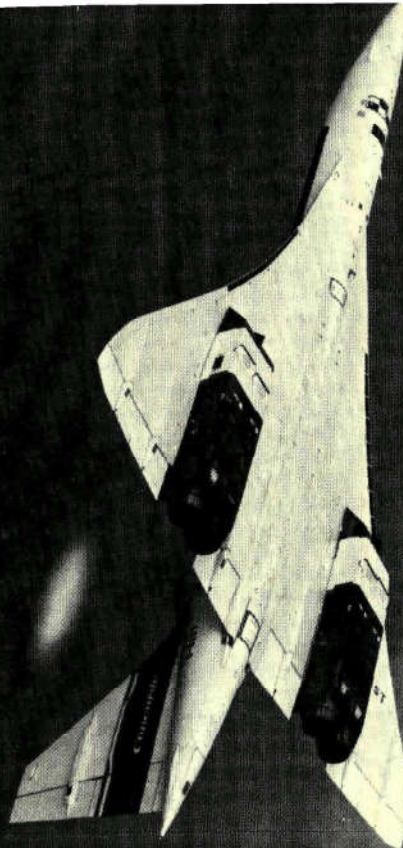
For some time BAC has believed that the answer to the problem of selling Concorde seats rests with the philosophy that the aircraft will be operated in a single-class configuration, with fares set at or below the current first-class levels. If the passenger amenity and comfort standards are similar to current first-class standards then the manufacturers take the view that it is virtually certain that, on routes where Concorde is operated, all the first-class passengers (some 10 per cent of the total traffic) will wish to fly by Concorde.

It can be shown that a fare at or below first-class levels would also be attractive to a considerable proportion of the business traffic at present flying economy class, giving Concorde some 20 per cent to 25 per cent of the available market. This marketing technique, so the manufacturers' argument continues, would allow subsonic aircraft to be operated in all-economy seating configurations, and therefore at reduced seat-mile costs. This assumes a stabilised situation in 1975 and beyond when traffic should have caught up with capacity, and the 747, together with the trijets, could gain some useful benefit from being operated in an all-economy layout.

At present, for a surcharge of about 50 per cent to 70 per cent over the economy fare level, the first-class passenger on international flights enjoys a somewhat higher standard of cabin amenity than the economy-class passenger, but he receives no advantage in speed. In the single-class Concorde operation, amenity standards approaching those of present first-class cabins could be offered in conjunction with the enormous passenger appeal of halved journey times, at a fare level about 10 per cent below first-class international fares or at a premium of about 40 per cent over the economy fare level.

For operations in the US domestic market, where the differential between first-class and economy-class fares is

The US Boeing 2707-300 SST is no longer a direct competitor for Concorde, but a second-generation Anglo-French SST is receiving some attention from BAC/Aérospatiale project definition teams. The troubles of the Boeing SST may have increased the long-term Concorde sales potential and which was directed at Concorde, with lobbying, much of which was directed at Concorde, with the overall aim of killing the US SST. But being the front runner in the western world's commercial SST stakes may now leave Concorde wide open to such pressures.



FLEETS AND FARES ...

fore, appears necessary. But the solution is not as simple as that—Concorde is designed to attract only certain sections of the traffic. This Concorde slice is expected to be made up of all the first-class passengers—the high-revenue-yield element in today's traffic—plus a significant proportion of the economy business market. These passengers may no longer wish to fly on subsonic aircraft, so the dilution of the revenue yield of the remaining traffic must be taken into account when computing the profitability of the mixed fleet. Equally the effect of potentially improved operating costs of subsonic aircraft in the mixed fleet resulting from their then all-economy seating layout must also be considered.

The claim that the average break-even load factors of mixed supersonic/subsonic fleets will be lower than those of an all-subsonic fleet is justified by BAC as follows: the average revenue yield for an all-subsonic fleet operating on a stage of 3,000 n.m. is 6.12 cents/pass-n.m. Total operating costs for the 747 are expected to stabilise at

around 5.19 cents/seat-n.m. at 1975 prices, giving a break-even load factor, assuming 344 seats, of 52.1 per cent. In the mixed fleet, Concorde revenue yield at first-class minus 10 per cent fares will be 10.26 cents/pass-n.m. Total operating costs are 4.8 cents/seat-n.m., giving Concorde a break-even load factor of 46.7 per cent. Since Concorde attracts the high-yield passengers in the market, the revenue yield of the remaining subsonic traffic (at 5.37 cents/pass-n.m.) drops below that of the all-subsonic fleet. However, the all-economy 386-passenger seating layouts will have reduced 747 operating costs to 2.78 cents/seat-n.m., giving a mixed-fleet subsonic break-even load factor of 51.8 per cent.

The average mixed-fleet break-even load factor now stands at 49.3 per cent, which is three points lower than in the all-subsonic case (assuming the optimum ratio of Concorde to 747s). Computations become more complex when 707s, DC-8s and wide-bodied trijets are accounted for, but the results are equally encouraging for Concorde. A one percentage point change in break-even load factor can mean millions in terms of airline profit. As an example, BOAC's annual costs for 1969-1970 were £166

CONCORDE OPTIONS

Air France	..	8	Air India	..	2
BOAC	..	3	Japan Air Lines	..	2
Pan American	..	3	Sabena	..	2
Continental	..	8	Eastern	..	6
American	..	6	United	..	6
TWA	..	6	Brasat	..	3
MEA	..	2	Air Canada	..	3
Qantas	..	4	Lufthansa	..	3
Overall total 74					

million. A one-point reduction in break-even load factor would have increased profits by £2.8 million. At a typical anticipated load factor of about 70 per cent, BAC thinks it probable that Concorde could help the airlines obtain a return-on-investment figure of around 15 per cent to 16 per cent.

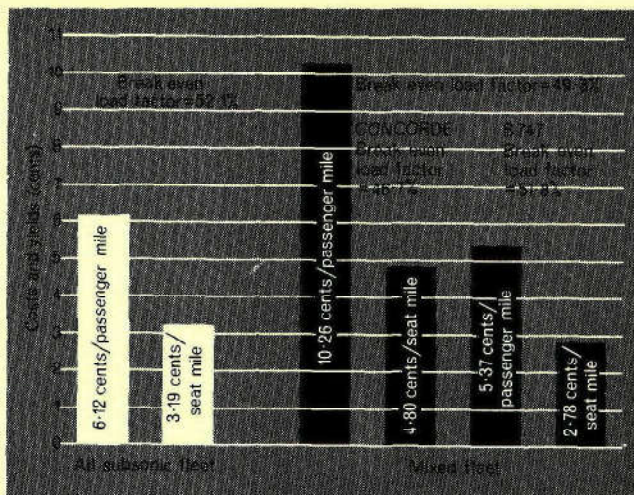
The traffic which would pass to Concorde on the basis so far outlined of single-class operations should have resulted in a market for 250 Concorde by 1980. But events of the past two years, and specifically the advent of 40-day excursions at the Iata fares conference in Caracas, have begun to initiate a more flexible approach to Concorde marketing. It has been found that businessmen—the cream of the Concorde market—have been taking advantage of the very much cheaper excursion fares. These were originally aimed at increasing the tourist traffic to the point where higher load factors overcame the disadvantage of reduced revenue yield per passenger.

The yardstick for estimates of Concorde market penetration has always been the differential between what the businessman pays for subsonic travel and what he will be required to pay for Concorde fares. The market for a single-class 112-seat Concorde, with a relatively high passenger fare surcharge by comparison with excursion fares now increasingly favoured by the business community, therefore appears to have contracted, possibly to 150 aircraft sold by 1980, or a 15 per cent market penetration.

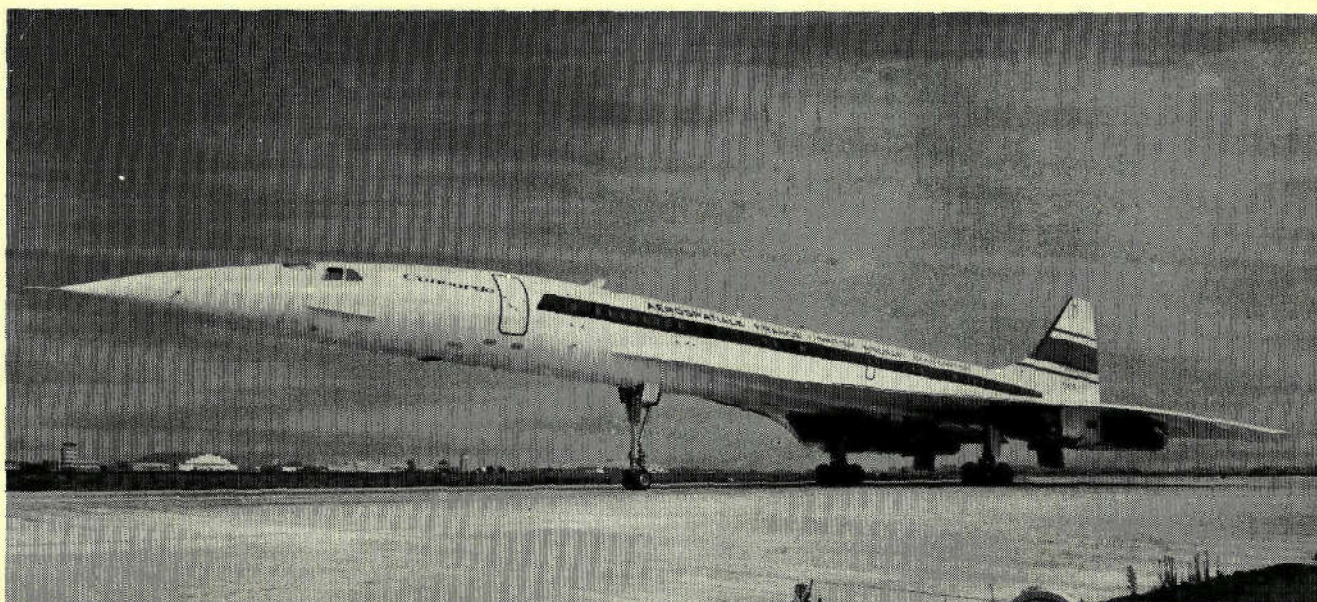
Concorde will make money for the airlines in the single-class configuration, but under the present Iata fares policy a more conventional 112-seat mixed-class layout is gaining support—restoring the higher market estimate—and is favoured by a number of airlines, including BOAC.

The mixed-class layout will probably involve installing 36 first-class seats and making a surcharge on first-class fares of 10-20 per cent, while running the rest of the aircraft at a lower surcharge over economy prices than was possible for the whole passenger load previously. The Concorde sales team is confident that not only will the first-class passenger flock to Concorde at existing first-class or slightly lower prices, but that little inducement will be required to get him to pay another 10 per cent or 20 per cent on top of the existing subsonic 50-70 per cent first-class fare differential. He will have the benefit of halved journey times combined with full first-class service and seating standards, apart from a little loss of seat width. The 36 first-class passengers would be seated at a full standard 42in pitch.

Now, by increasing the yield from the forward cabin

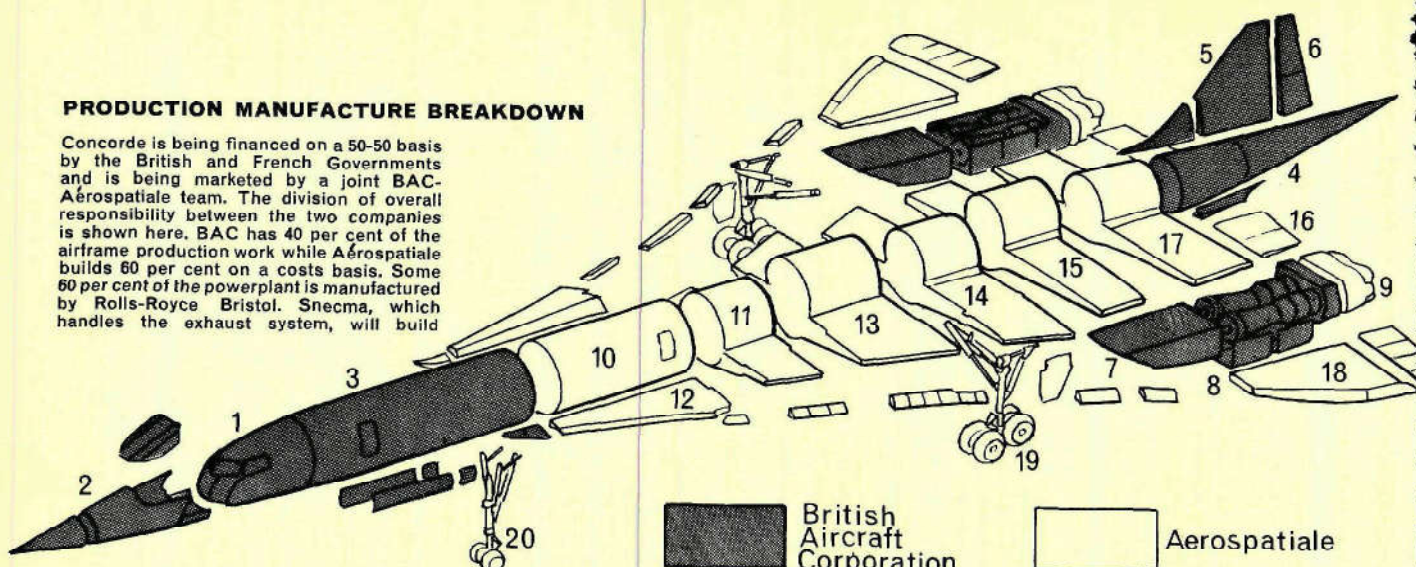


Above, Concorde the money-spinner—a comparison of costs and yields for an all-subsonic fleet and a mixed fleet of 747s and Concorde fitted with a superior, single-class seating layout, below. Nozzles demonstrated in the Arthur Gibson photo of 002 opposite and the visor shown on 001, bottom, will both be modified on production aircraft



PRODUCTION MANUFACTURE BREAKDOWN

Concorde is being financed on a 50-50 basis by the British and French Governments and is being marketed by a joint BAC-Aérospatiale team. The division of overall responsibility between the two companies is shown here. BAC has 40 per cent of the airframe production work while Aérospatiale builds 60 per cent on a costs basis. Some 60 per cent of the powerplant is manufactured by Rolls-Royce Bristol. Snecma, which handles the exhaust system, will build



25 per cent of the flange to flange production engine to maintain its overall 40 per cent share of the powerplant work. Final assembly of production engines is to take place in both Britain and France, allowing most of the Aérospatiale requirement to be supplied from France.

Twin Concorde production lines will supply the airlines from Bristol and Toulouse. As far as possible each airline will receive all its aircraft from one of these sources, although the Pan American delivery positions will require the airline to tap both lines.

Both Concorde 002, below, and 001 are fitted with Olympus 593-3Bs which allow sustained Mach 2 flight but produce considerable smoke. Annular combustion chambers will eliminate smoke on production engines

COMPONENT	DESIGN	MANUFACTURE
1 Fuselage nose	BAC Filton	BAC Weybridge
2 Droop nose	Marshall's	Marshall's
3 Forward fuselage	BAC Filton	BAC Weybridge
4 Rear fuselage	BAC Weybridge	BAC Weybridge
5 Fin	BAC Weybridge	BAC Weybridge
6 Rudder	BAC Weybridge	BAC Filton
7 Air intake	BAC Filton	BAC Filton/Preston
8 Engine/Nacelle	R-R Bristol/BAC Filton	R-R Bristol/BAC Filton
9 Nozzles	Snecma	Snecma
10 Intermediate fuselage	BAC Filton	Snias Marignane
11 Centre wing	Snias Toulouse and H. Dubois	Snias Marignane
12 Forward wing	Snias Suresnes	Snias Bouguenais
13 Centre wing	Snias Suresnes and La Courneuve	Snias Bouguenais
14 Centre wing	Snias Toulouse	Snias Toulouse
15 Centre wing	Snias Toulouse	Snias Toulouse
16 Elevons	Snias Suresnes	Snias Toulouse
17 Centre wing	Snias Toulouse and Fiat	Snias St Nazaire
18 Outer wing	Dassault	Snias
19 Main landing gear	Messier-Hispano	Messier-Hispano
20 Nose landing gear		



area of Concorde, the airline could afford to reduce the supersonic surcharge for the remaining 76 passengers who would now sit at the standard 34in pitch in economy seats. In the single-class concept all passengers would sit at 38in pitch with rather less than current first-class comfort.

Concern has been expressed that passengers will not wish to return to the narrow fuselage of Concorde after several years of 747 flying. But interior design by Charles Butler Associates of New York is aimed at minimising the effect by the use of blocks of boldly coloured seats to break up the cabin visually and, personally, I find the mock-up far from unbearable, especially when the reduced journey times are considered.

The basic principle behind all the possible seating layouts remains the same—to carry all existing first-class passengers and the businessmen, leaving subsonic aircraft to operate more profitably, in all-economy-class layouts. The mixed-class formula broadens the capture area by reducing the differential between supersonic economy and subsonic economy/excursion fares. However, it shows up yet another possible permutation of an already complicated fares policy which will take some thrashing out by Iata. This is an area in need of action within the next two years.

The arguments postulated above apply to the period beyond 1975, but initially, when Concorde capacity is very short and demand is high, some interim fares structure might be sought. Under these conditions Concorde might make money on 30 per cent load factors.

P.M.

Radio aids—what does the future hold?

THIS ARTICLE is concerned with the part that electronics play in the safe and expeditious point-to-point movement of civil aircraft. This may seem an elaborate way of saying that it is about navigation but, as we shall see, this word has rather unfortunately acquired a specialized meaning in the aviation context. Communication and surveillance are as much involved in the overall operation of moving an aircraft over the Earth's surface, and the total implications in terms of hardware and system complexity are, in 1971, formidable.

Consider the accompanying table of avionics sub-systems which lists all the aids which are in either current use or an advanced state of development. The first category of equipment covers the basic package which is mandatory for operation in controlled airspace as defined by Icao. Group two consists of equipment which is almost certainly to be found in the fleets of scheduled carriers, and the third group lists the current choice available in en-route navigators. Finally are listed those items which are likely to see operational service before the end of the present decade.

Although all the 21 items tabulated are unlikely ever to be found in one aircraft, it is nevertheless clear that this table represents a very large total capital investment. For the basic avionics package in the Islander (items one to five), the price quoted (July 1970) by Britten-Norman using King Radio equipment was £2,852. This is a modest sum when related to the total aircraft cost, and due to the extensive use of solid-state circuitry the complete package involves a weight penalty of only 32lb, 13.6kg basic item weight. But a current trans-oceanic airline installation will typically consist of items one to ten plus at least one of items 11 to 15, at a price (due to the necessity of meeting ARINC specifications and multiple installations of some items) in excess of £50,000; if triple inertial navigation is fitted another £100,000 can be added.

Even more significant than the capital cost, however, is the weight penalty. The unit weight of the basic airline installation is of the order of 500lb, 220kg, but due to the requirements for back-mounting, inter-unit cabling and power supplies this represents only about 40 per cent of the total installed weight of 1,250lb, 552kg. It is on this figure that many airlines assess a "weight-revenue" penalty. This is a rather arbitrary factor which depends on the routes flown, a seat loading factor, the type of aircraft and the way the airline does its accounting, but some operators use figures as high as £100 per pound weight per annum. Even on the simple assumption of 200lb, 90kg as the weight of an average passenger, it is apparent that the equipment penalty of a conventional nav/comm installation is around half-a-dozen passengers per flight. To this must be added the direct costs of holding stocks of spares and specialised test gear and maintaining repair shops. Also for consideration are the indirect costs arising from the flight-deck workload and the crew training entailed by the wide diversity of equipment carried.

The electronic element associated with aircraft movements thus carries economic penalties, especially when it

VIONIC SUB-SYSTEMS

	I	II	III	IV
1 VHF communication	X			
2 VHF navigation (VOR)	X			
3 Instrument landing systems (ILS)	X			
4 Marker beacon receiver	X			
5 Automatic direction finder (ADF)	X			
6 Distance measuring equipment (DME)	X			
7 SSR — ground radar	X			
8 Radio altimeter	X			
9 Weather radar		X		
10 HF communication		X		
11 Decca Navigator		X		
12 Loran		X		
13 Conesol		X		
14 Omega		X		
15 Doppler navigation		X		
16 Inertial navigation		X		
17 Computer — area navigation		X		
18 Displays — moving chart		X		
19 DME		X		
20 Collision-avoidance system (CAS)			X	
21 Clearair, turbulence detection (CAT)				X

Integration candidate

position by methods either wholly independent of the aircraft—primary radar—or which require special equipment in the aircraft which reports independently of the aircrew. Secondary radar transponders achieve this, as can any externally referenced navaid with the addition of data link.

In the satellite context, the most obvious method of position fixing is by making measurements of the ranges from two satellites to the aircraft and computing the position on the ground or re-transmitting it if required. This is, however, the least economic way of using satellite channel capacity, since it requires a "there-and-back" transmission of a ranging signal to each satellite as well as any re-transmission of the ground-computed data. And there is also a considerable system organisation problem inherent in high numbers of users, since each of the pair of ranging signals must be made simultaneously if errors due to aircraft movement are not to be introduced.

Because of the relatively low cost-effectiveness of the two-range method, and the necessity of carrying specialised and expensive airborne equipment from which position data is not directly obtained, this approach has found little favour with the airlines. Unfortunately, being the most obvious method, it has inevitably been the most widely discussed, and airline hostility has quite unnecessarily spread to the basic concept of any form of satellite navigation. In addition to clouding their view of the great advantages which more elegant (and cheaper) concepts might bring, airlines seem to have lost sight of the fact that a very large number of them will never be able to afford to fit triple inertial equipment to their aircraft. Since it is only when all users have the same basic navigation capability that the long-awaited reduction in separation standards can be achieved, airlines have as much to gain indirectly from the adoption of a universal cheap navaid as they now gain directly from their inertial installations.

No doubt a good proportion of the large FAA budget will be directed to the evolution of a much wider range of system concepts than Europe could hope to envisage, and it is inevitable that America will produce the satellite component of such future navigation and ATC systems and will accordingly reap the financial harvest. There are, however, other means of attaining a useful measure of system integration, and among these the Mullard Interferometer approach (noted briefly in last week's *Avionics* column) must rank very high. Extension of this technique, originally conceived and currently promoted primarily as a landing aid, would constitute an approach from an entirely different standpoint compared with the use of satellites. But for both the concept of a universally fitted airborne unit is fundamental, and there are several other points of operational similarity.

Area navigation is here—now

ground environment required was regarded as an expensive investment and, from the operator's point of view, there was a strong prejudice against the presentation of primary navigation information on charts that were, to the untutored eye, distorted. The combined attractions of simple point-source VHF "beacons," capable of discreet tracking to or from any radial by means of a simple left/right needle, were more appealing.

What has brought about the change of thought? On the one hand the growth of air traffic along the narrow corridors defined by VOR has led to an increasing number of conflicts in traffic patterns. Conversely, the increasing density of traffic demands multiple-track capability, and the fixed ground station VOR network is not flexible enough to cater for the need. Finally, again because of the increasing density, there has grown an ever-wider use of radar positioning which has caused aircraft to be turned away from the defined tracks and left with no on-board navigational guidance.

The structure of airways and advisory routes in the

remembered that all but the eighth and ninth of the first 14 items of the above table involve ground installations (although marine use of some of the systems bears a portion of the burden). In addition, there is a worldwide investment in primary and secondary radars with their associated ATC computers, displays and data-handling networks.

At this point, therefore, it seems appropriate to question whether the total electronic environment in which civil aviation has to operate is all it should be. Diversity has always been regarded as an essential feature, but are we not now paying an unnecessarily high price? And we appear to be moving in the direction of even greater complexity: later in-service versions of Concorde and other advanced aircraft are likely to carry not only items one to ten, but 16 to 21 as well, plus one or more of the radio nav aids. No wonder airlines lose money.

Clearly there is scope for improvement, and although there are certain items, such as weather radar, which perform such limited functions that they cannot really be embodied as an extension of a basic nav/comm system, it is obvious that great economies could result from the integration of many of the current facilities.

This approach has, not surprisingly, been extensively studied in the US for some years, and a very useful introduction to it is contained in a paper by the director of advanced studies at the USAF Rome Air Development Centre ("Improvements in CNI—Will They Help Create a New Air System?" by I. J. Gabelman—*Aeronautics and Astronautics*, February 1969). On this basis all the items with crosses in the table can be identified as candidates for a unified system, and the economic implications of replacing these with a single black box are very striking.

The studies outlined in the USAF paper were based on a satellite system, and it is accordingly not surprising to learn that the FAA proposes to spend \$100 million over the next ten years on a space-based solution to its ATC problems; in addition to the obvious advantages in the aircraft, the FAA believes that this will permit a great reduction in the need for Air Traffic Centres and make a major contribution to the area-navigation concept.

The key element in such a system is the method used for the fixing of positions. At present considerable operational significance is attached to whether this is done by wholly self-contained aids based on inertial or Doppler techniques, or by externally referenced systems such as Decca or Loran. Both kinds of aid give navigation data, as opposed to surveillance, which provides information on

PERHAPS THE MOST REMARKABLE THING about area navigation is not that it is here but that it has taken such an interminable time to arrive. In a sense the wheel has turned through the full circle since the fateful decision taken at Montreal in 1959 to adopt VOR/DME as the basic navigation aid throughout the world's airways.

It has stood to Decca's credit that the company has always held that a unique track system would be too easily saturated and that, through congestion at point-source aids, a real collision risk could exist. It is tempting to retrace the arguments put forward at the time of the Montreal meeting and to deduce that the wrong decision was made and yet there seems little doubt that the increasing use of area navigation which can be confidently predicted at the moment arises in no small measure from the way in which the avionics industry has applied itself to producing equipment compatible with the VOR/DME network.

In retrospect, the case against Decca almost certainly rested on two principal factors. On the one hand, the

AIR NAVIGATION . . .

United Kingdom airspace was originally defined by NDBs (Non Directional Beacons) and these have been progressively replaced by VORs sited to support the same structure. Of the 43 installations in the British Isles, only one is so positioned that it does not contribute to either airway or terminal routeing, that being the quasi-test installation at Cranfield. Since the United Kingdom airways essentially follow the spine of the country, there are large areas of eastern England, Wales and the West Country which are almost without VOR coverage—at least in the lower levels.

America suffers in a similar manner from its VOR disposition but with an added complication due to the lack of terminal approach facilities at many airfields which are increasingly being used by commuter airlines, business aircraft and air taxi operators. Perhaps in the United Kingdom we do not fully appreciate the significance of this aspect of area-navigation development because our traffic is still in the early stages of comparable growth. We tend to think of area navigation solely in terms of its multiple-track potential but it is inherent in all new R/Nav equipment that an IFR descent can be made into virtually any airfield.

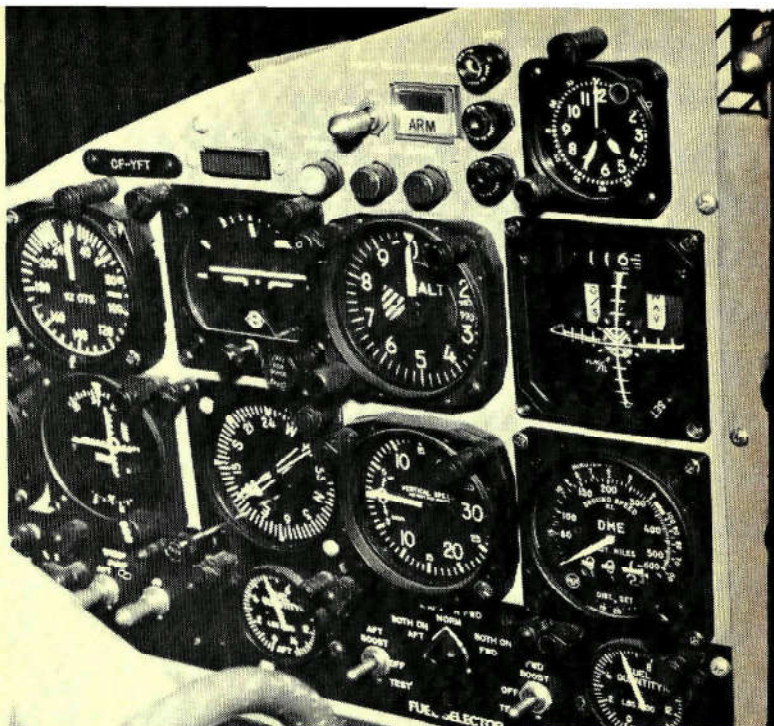
Accepting that the growth of relatively cheap R/Nav systems has resulted from an ability to turn the VOR/DME network to the best advantage, I do not propose to include within the scope of this review the inertial systems which are becoming universally adopted for long-range airline operations. Rather I intend to consider the lighter end of the scale where a number of realistically priced packages are now becoming available.

The essence of these systems is common and is simply the ability, electronically, to create "ghost" VORs based on existing installations. The term "waypoint" is now generally applied to a VOR which has been apparently moved, and in all cases the waypoint is achieved by dialling in a range and bearing from the real VOR, to which the receiver is tuned, to the destination. Already in the USA, thanks to the participation throughout many trials of the Jeppesen organisation, approach charts are published showing IFR cloud-break procedures; these are dependent on creating a waypoint at the touchdown threshold which relies for its signals on a VOR up to 50 miles away. It is self-evident that when the DME can be similarly "moved," approach patterns have all the accuracy to be expected from an airfield-based aid.

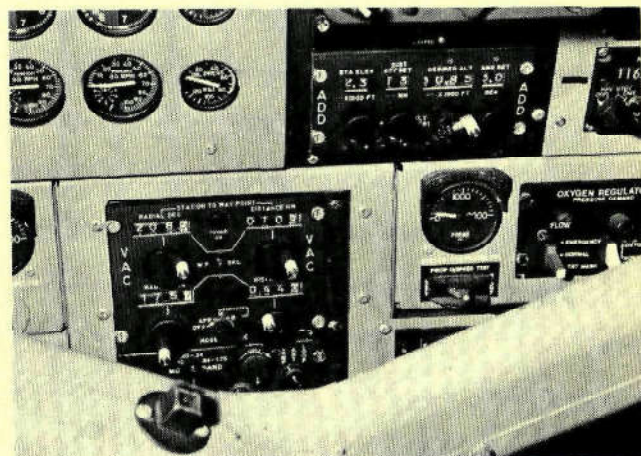
The most deluxe of the R/Nav equipment at present on the market, and also the most refined, is the Butler National VAC (Vector Analog Computer) of which one example has been seen in the United Kingdom during a demonstration tour by a Twin Otter. The presentation of the Butler system is in the form of a course director instrument not unlike the conventional ILS indicator. The vertical needle is used to indicate distance off track while the horizontal needle measures distance to go to, or distance run from, a DME waypoint. The control unit allows the pre-selection of two waypoints and one advantage of the Butler system is that the DME range to the fixed origin can still be seen as well as the range to the "ghost station."

Although the instrument has scale markings which appear the same as those of an ILS indicator, they represent linear rather than angular distances and the scale of the divisions can be varied to make each equal one, two or ten nautical miles. The display is made even more informative by the drift indication which is given by rotation of the small aircraft at the centre of the instrument.

Butler has extended the area-navigation concept into the vertical plane with its ADD equipment with which it is possible to dial in a requirement to gain or lose a specified height over a pre-determined distance. The computer will calculate the point at which the climb or descent should begin and will provide profile guidance through the conventional ILS indicator. Altitude warning is built into the equipment and the vertical capability is fully

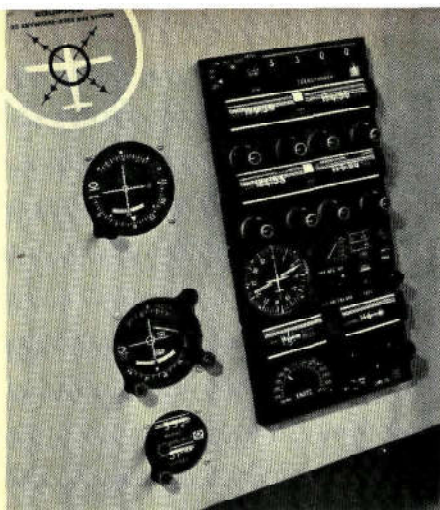


The complete Butler VAC system installed in a Twin Otter. Above, the Symbolic Pictorial Indicator occupies a dominant position on the instrument panel alongside the altimeter. The dual waypoint selector unit is immediately behind the control column yoke, below, and vertical profiles can be demanded from the ADD unit above it and to the right

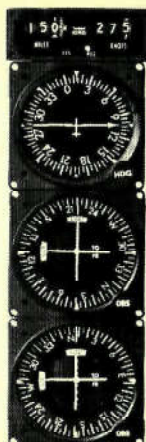


integrated with the flight control system. The integrity of a let-down flown using equipment such as the Butler VAC depends on the distance of the real ground station from the desired point of touch-down. When the VOR is 50 miles from the landing runway the system must be regarded as a cloud-break procedure with a weather minimum of the order of 700ft, but if the transmitter is only five-ten miles away then this minimum figure can be markedly reduced so that operations down to 200ft minima become a possibility.

In a study carried out for Butler ten major accidents which occurred in the landing phase in the United States between 1967 and 1970 were analysed to see whether the application of a 3D R/Nav technique might have avoided the accident altogether. In each case the subject aircraft was making an IFR approach without a full ILS system being available for approach guidance, and in each case there was a Vortac transmitter within ten miles of the touchdown point. In two of the most serious accidents considered, accounting for a total of 105 fatalities, the air-



Two contenders for the lightweight R/Nav market. On the left a complete Narco display including CLC-60 and display at the bottom. The King installation, right, includes a KN 74 R/Nav controller below the ADF controller



530
FLIGHT International,
15 April 1971

AIR NAVIGATION . . .

craft were making a descent using an ILS localiser, but with no glideslope information due to ground station unserviceabilities. Both aircraft crashed short of the runway threshold and there can be little doubt that had descent guidance been available neither accident would have occurred.

The Butler VAC system has been subjected to intensive trials in the United States, one of the best documented being the American Airlines comparison of three area-navigation systems for Stoll application. These were flown using a McDonnell Douglas 188 in the New York, St Louis and Chicago areas. The Butler VAC was measured against a Litton LTN-51 inertial system and a Decca Omnitrac, the latter being used both within a Decca hyperbolic chain and actuated by conventional VOR/DME inputs. Following the Stoll trials American Airlines installed Butler systems in two Boeing 727s employed on short-haul operations between Chicago and New York.

Eastern Airlines, another short-haul operator in the New York, Washington and Boston area, completed similar detailed studies of area-navigation potential during 1968 and 1969 with the emphasis on the Decca Omnitrac system. The heart of this equipment is the Omnitrac computer developed in 1964, originally so as to provide representational charts for the Decca pictorial display, thereby overcoming one of the earlier objections to the Decca system. However, the practical value of the Omnitrac computer has been the flexibility of inputs which it is capable of accepting from the long-range Loran or Doppler equipments to the short-haul VOR or DME. Since the Omnitrac does not need the traditional Decca ground environment it has been able to compete with the newer, purpose-developed, systems and Eastern followed its trials by specifying Decca for all its short-haul equipment. The final accolade came when, in May 1970, the company settled on Decca equipment for its DC-9 fleet. While the steady development of Decca over 25 years stands it in good stead it has always been an expensive choice for an airline to make. The basic Omnitrac costs approximately \$45,000 and to this price must be added a further element for the particular inputs required by the user; this figure contrasts unfavourably with the total price of the Butler VAC system of some \$16,000.

Turning now to the lightweight and low-cost equipment

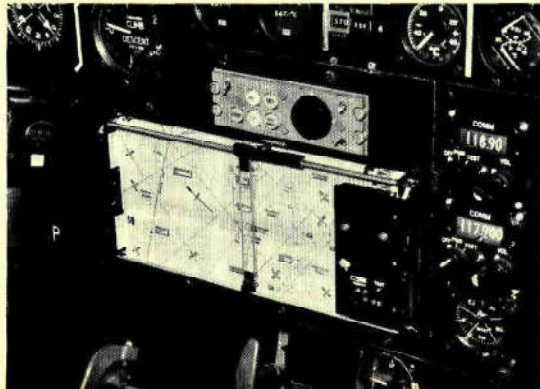
available for small aircraft, both Narco and more recently King has entered the market with course-line computer systems. The first of these, the Narco CLC-60, has been flying since 1968 and was first seen in Europe at the 1970 Hanover Air Show. The equipment carries out its triangulation sums by means of a small analogue computer and the heading information is displayed to the pilot on an instrument virtually identical to a normal Narco VOR/ILS display. A simple controller enables the pilot to dial in his offsetting data, the radial and the distance being given on a digital display. The CLC-60 is compatible with the lightweight DME-70 and enables distances to be measured to either the waypoint or the basic ground station, but not both simultaneously. CLC-60 costs approximately \$3,000 and is thus a very attractive proposition for the light-aircraft owner.

At the NBAA convention at Denver last September King introduced its KNC 610 area-navigation computer which was a logical development following the company's entry of the navigation display market with the KPI 550 indicator.

King has designed the computer to be compatible with its Gold Crown avionics family, and has made it a panel-mounted unit requiring a standard 3in instrument panel space and weighing only 3.3lb. A complete package comprising navigation frequency selector, receiver, pictorial navigation indicator, digital DME and R/Nav computer is priced at \$11,000.

The King Silver Crown line for lighter aircraft has also been augmented by an R/Nav equipment. This is a panel-

The leading British advocate of area navigation has been Decca whose latest equipment, Danac, is seen below installed in a Skyvan during trials for British Air Services



AIR NAVIGATION ...

mounted "flat-pack" unit retailing at \$2,000 and (together with its associated comm/nav equipment and VOR indicators) is FAA-approved.

From its early, expensive, beginnings area-navigation equipment has become progressively lighter and cheaper until it has reached the present state of being adaptable to any class of aircraft. The impetus, having 12 years ago been entirely British, now stems from the United States, partly because the congestion problems of that country's airspace demand urgent solution and partly because of the advances in technology displayed by the American avionics industry.

In the United Kingdom perhaps the greatest benefit which may accrue from the use of lightweight R/Nav equipment will be that general-aviation aircraft will no longer be forced to fly in the narrow confines beneath controlled airspace in order to make use of existing ground radio facilities. The day when the evil reputation of the airspace immediately above the Daventry VOR can be forgotten cannot come too soon for the many pilots who at present have no choice but to use this highly congested area as one of their primary means of navigation in the Midlands.

H.F.

Honeywell on the ball

AFTER EIGHT YEARS of development under a joint programme between Honeywell and the USAF Avionics Laboratory, flight trials are now under way with the

Gimballed Electrostatic Aircraft Navigation System (GEANS). The heart of this new inertial system is the electrostatic gyro (ESG), a polished beryllium ball of 1½in diameter which rotates within an electrically charged field inside a vacuum chamber. Because there is no contact with the walls of the chamber the ESG overcomes many drift uncertainties and other inaccuracies which are found in conventional gyros. The ESG is spun at extremely high speeds and it can rotate for long periods of time in the vacuum chamber because of the minimal drag force compared to the momentum of the rotor.

The first development model ESG produced by Honeywell was tested by the USAF in 1967 but the present trials, and those shortly to be conducted by the USAF at Holloman AFB, New Mexico, will encompass a complete modular navigation system. The system is built up from four quickly replaceable units, an inertial measuring unit, an electronics assembly unit, a Model 601 digital computer and a control display unit. Built-in test capability is included and Honeywell anticipates a 90-day instrument calibration cycle and not more than 0.2 maintenance man-hours per flying hour.

Discussing the new system recently, Mr John W. Minor, Honeywell deputy director of guidance and navigation, said that the GEANS had been designed to fit the navigation needs of advanced command and control aircraft such as Awacs, the USAF's Airborne Warning and Control System, as well as other programmes that require a highly accurate, all-weather navigation capability. It offered high-precision performance over long flight periods with no dependence on navigation aids but it could equally be used as a hybrid system if so desired by the customer. The second ESG unit which is due for delivery this month will be tested in association with a USAF Doppler inertial aid.

SPRIGHTLY STOL

The Breguet 941S, which in its McDonnell Douglas 188 form was the vehicle for the New York comparative trials of three area-navigation systems, is seen in this photograph in the more familiar environment of a strictly visual tactical Stoll approach



WILDCAT WORK-OUT



NEXT MONTH SEES A SIGNIFICANT EVENT in Royal Air Force helicopter history—the start of formation of its first squadron of aircraft supplied under the 1967 Anglo-French helicopter package deal. These are the Snias-Westland SA.330E Pumas, the type formally handed over to the RAF on January 29 this year (*Flight*, February 4 and 18) and due to be operated first by 33 Sqn at Odiham, Hants. A second squadron, No 230, is being formed there later this year. The RAF will have 40 Pumas all told, built jointly in France and the UK.

Since the new helicopters have been at Odiham, the Air Training Sqn there has been proving them both in the air and on the ground. The French Army, whose Pumas are basically the same as those of the RAF, has already accumulated more than 15,000hr flying experience on the type. None of this has been passed on to the new operators, 38 Group of Air Support Command; and apart from four weeks which some of the RAF crews spent with Snias at Marignane (three weeks' ground school, one week flying), the

Air Training Sqn has had to discover the Puma for itself at Odiham and over the green fields of Hampshire.

First impressions of the new type, both as a flying machine and as an engineering task, have been favourable. Ample power (two Rolls-Royce/Turbomeca Turmo IIIC4s giving a take-off power of 1,300 s.h.p., 970kW at 33,450 r.p.m.) is allied to streamlined design, good capacity—e.g., for 16 armed troops—and pleasant handling characteristics. As far as servicing is concerned, the bull point in favour of the Puma (which was fully described, with a cutaway drawing, in *Flight* for May 14 last year) is the accessibility of its engines and controls through fold-down cowlings and hinged covers. Its acceptability to the engineers, and the success of logistics planning, were shortly to be proved by the first 100hr inspection.

Flight recently visited the ATS at Odiham to talk with its OC, Sqn Ldr Barnet Swinton-Bland, about RAF Puma progress; and while there the journal's representative had the experience of flying in one of the new

helicopters with the Puma Flight commander, Flt Lt Dickie Langworthy.

Sqn Ldr Swinton-Bland said that initially the Puma pilots and crewmen (one of each per aircraft) would be second-tourists, that is, already experienced on the Whirlwind or Wessex. The crewmen, first of whom arrived at Odiham at the end of March, do a ten weeks' course—five weeks on the ground and five in the air, teamed up with a pilot. The pilots do one week's ground school before their four weeks' flying. Later, the pilots trained at Odiham for Puma squadrons will be doing their first tour on the type.

When fully operational in the RAF, Pumas will work side by side with the Wessex and can perform four different roles, as required according to operational needs: troop carrying (16 armed soldiers, four of them facing inwards, 12 sitting back to back); freight transport (about 3,500lb, 1,588kg payload, with full fuel and two crew) with either a distributed internal load or one slung externally on a hoist depending from the main gearbox; casualty evacuation and SAR.

HUMPHREY WYNN AND TOM HAMILL VISIT THE RAF's FIRST PUMA UNIT

Two points in favour of the Puma as a troop carrier are that its wide doors on either side permit emplaning from both sides at once, which means that 16 soldiers can get aboard as quickly as ten can get into a Wessex; and once in, although there is insufficient head room for them to stand up straight, they can see where they are going through the side windows or ahead between the two pilots' positions. The troop leader can, if necessary, communicate physically with the pilot since the flight deck and passenger compartment are on the same level. Also cabin heating/air conditioning is better distributed than in the Wessex, giving overall warmth instead of hot pilots and frozen soldiery, or cool occupants, according to the climate. On the other hand, the Puma is not so robustly constructed as the Wessex, its fuselage less resistant to the possible misplacing of soldiers' boots.

Flight's air experience of the Puma was gained on a normal training flight, with Flt Lt Langworthy as instructor and Odiham's station commander, Gp Capt J. A. G. Slessor, as pupil. The latter, a qualified helicopter pilot, was flying the Snias-Westland type for only the second time.

External checks on the Puma are aided by certain visual indicators, like the oil level sight located just aft of and above the flight deck on the port side, and access is normally through the starboard-side passenger compartment door. Gp Capt Slessor occupied the first pilot's (right-hand) seat and Flt Lt Langworthy the left-hand seat. Once the pre-flight checks had been done (monitored by another instructor), *Flight's* representative occupied the jump seat between the two pilots.

Switches, instrumentation (all metric) and controls are neatly and conveniently arranged in the Puma, being above, or in front of, the pilots' positions. Each pilot has a collective and cyclic pitch control, the latter having on it a trim switch and autopilot release button.

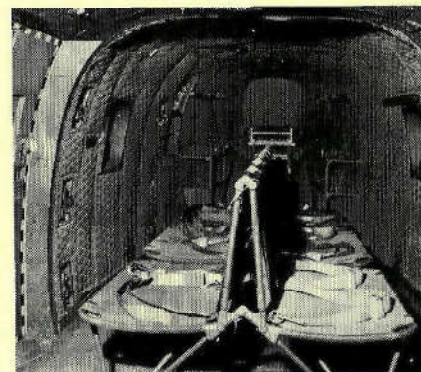
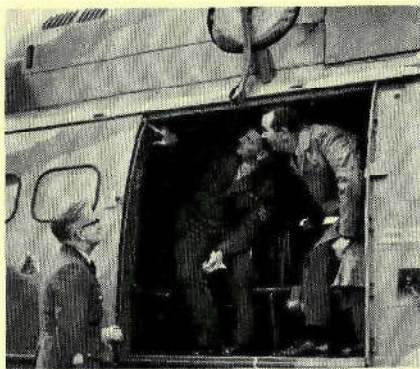
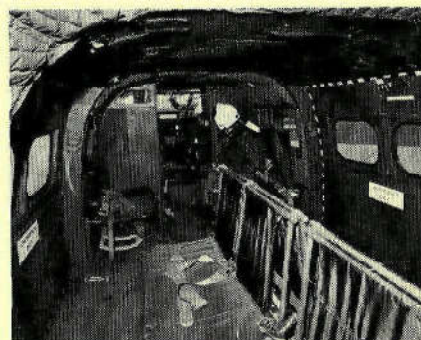
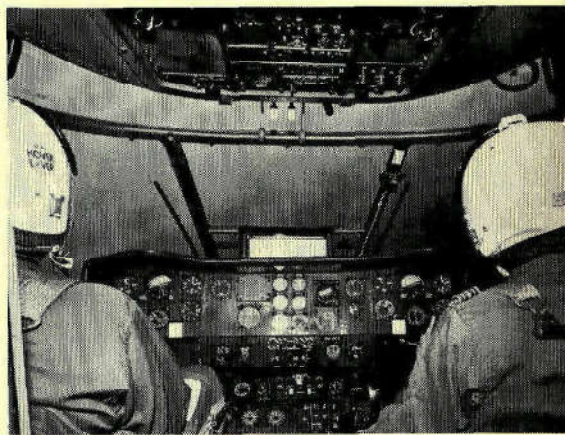
The autopilot, an SFIM-Newmark Type 127, is the key to the Puma's well mannered handling characteristics: it provides roll, pitch and heading stabilisation and turn co-ordination—so that, although termed an autopilot, it acts as a basic stability augmentation system. During our training flight from Odiham, Flt Lt Langworthy's instructional dialogue included the following: "If you're flying along and your autopilot comes out, there's no big problem. There, I've pulled it out for you. If you reduce speed by 10kt you get more stability."

The Puma is almost an all-weather aircraft, and the first RAF helicopter to have break-off approach limitations.

A Puma, of course, can be flown without its autopilot, but manual flying is much harder work. With the autopilot engaged, as it normally is, instrument flying is "a piece of cake" (to quote Flt Lt Langworthy); but he admitted that, when flying with it in, his hands were never far from the collective and cyclic pitch levers.

Starting is a simple, press-button business in the Puma, and once the throttles have been opened, they normally stay like that for the rest of the flight. A key flying instrument is the rotor pitch angle indicator, because this indicates the amount of power being deployed through the collective pitch control. For example, Flt Lt Langworthy commented during the flight: "We tend to use 12° as pitch

Pumas at RAF Odiham (facing page): note retractable landing gear. This page, from top: flight deck, with MEng Bill Parry in the left-hand seat and Flt Lt R. Langworthy on the right; Fg Off A. Shelley occupies one of the inward-facing passenger seats; below left, WO A. Holden, OC Engineering Flight (left), checks a door with CTech R. A. Wood and Sgt J. G. Perigo; below right, rearward-facing view of passenger compartment; bottom picture, Puma servicing, with (left to right) Sgt T. Chorley on access ladder, Cpl B. Barnes examining rotor head, SAC R. Petch and CT D. Barfoot



WILDCAT WORK-OUT . . .

to give us maximum fuel flow." When he was showing Gp Capt Slessor a simulated autorotation, speed was decreased to 70kt and with a 1,500ft/min rate of descent established, 7° rotor pitch angle was indicated.

Other advantages of the Puma were evident during this 1hr 15min flight, which ended with several practice landings back at Odiham airfield on grassy slopes of differing angles, providing a stiff test for a new pilot on the type: the helicopter's good visibility from the pilots' positions, for-

wards, sideways and downwards; high cruising speed (a maximum in the 147kt-155kt range); its effective single-engine performance; and its sheer "flexibility," with a performance akin to that of a fixed-wing type.

The Puma is a good accession to the helicopter strength of 38 Group, Air Support Command, and its virtues should be appreciated in service by both the RAF and the Army.

It carries more, and carries it faster, than the Wessex; and its good, auto-pilot-aided, handling characteristics should enable it to operate in all but the most impossible weather conditions.



First Poseidon Deployment

SCHEDULED TO BECOME OPERATIONAL at the beginning of 1971, the first Poseidon-armed US Navy nuclear-powered submarine, USS *James Madison*, left her base at Charleston, South Carolina, at the beginning of April. The refit with Poseidon G3s, replacing Polaris A2s, had been begun in February 1969. The missiles are launched from 16 vertical tubes within the hull. The next Poseidon-firing submarine, USS *Daniel Boone*, is due to put to sea this summer. *Flight's* World Missiles 1971 survey (March 18 issue, pages 374-392) pointed out that "despite the increased size of the new weapon, it can be housed in, and launched from, existing Polaris A3 launchers after slight modification of the tubes. . . . Poseidon is designed to carry

multiple individually targetable re-entry vehicles."

F-111s to Australia

CONTROVERSY OVER THE General Dynamics F-111s which had been ordered for the RAAF was revived in Australia at the end of last month when four USAF F-111s arrived in Queensland for the RAAF 50th anniversary celebrations (*Flight*, March 25, page 419). At the same time the Federal Minister for Air, Senator T. Drake-Brockman, said in Canberra that 24 F-111Cs ordered from the United States had failed to pass the fatigue tests and to meet the technical requirements demanded by the RAAF. Speaking in Parliament on March 31, he told the Upper House that the F-111s were still not allowed to fly at 100 per cent of their capabilities. The aircraft visiting Australia would be subject to flight restrictions.

Sen Drake-Brockman said that the US had agreed that Australia could defer acceptance of the F-111Cs until later this year. Under the agreement, specific operational and technical requirements must be met.

The USAF F-111s participating in the RAAF celebrations made a ten-

hour non-stop Pacific crossing from Honolulu (4,100 miles)—the longest so far yet made by the type—with five in-flight refuellings.

Venezuela's C-130s

THE VENEZUELAN AIR FORCE is gaining a large increase in transport capacity with its acquisition of four Lockheed Hercules C-130s. It at present has 45 transport aircraft—variously C-47s, C-54s and C-123B Providers.

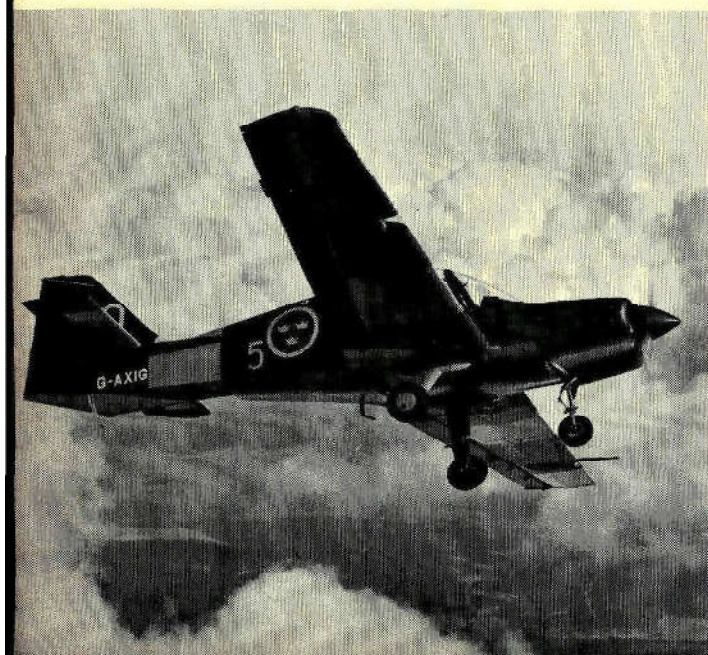
When President Rafael Caldera accepted the first two new aircraft on March 25, he said that the C-130s would be used in Venezuela's economic development. They will carry bulky road and airport building equipment to inaccessible parts of the country, airlifting material which previously had to be dismantled and flown in several of the smaller aircraft.

The VAF Hercules are C-130Hs with Allison T-56A-15 engines, which confer a 24 per cent increase in take-off power at hot temperatures and give higher cruising speed and lower fuel consumption.

India and Chinese ICBMs

THE LIKELIHOOD OF CHINA testing an intercontinental ballistic missile in the near future was referred to by India's Defence Minister, Mr Jagjiram Ram, in New Delhi on March 31. In a written Parliamentary answer he commented: "Our defence plans take into account the threats posed to our security."

An initial operational capability by the Chinese with ICBMs, within three years of the start of flight testing, was predicted by US Defence Secretary Mr Melvin Laird in his 1971 Defence Report to Congress last month (*Flight*, March 18 and 25). Saying that the start of testing had not yet been confirmed, he added that a reduced launch test of an ICBM might have taken place in late 1970, so that the earliest possible date for deployment would be 1973.



Scottish Aviation's second prototype Bulldog Series 100 with Swedish Air Force markings. Below, Grumman EA-6B Intruder all-weather ECM aircraft which has recently entered US Navy service. It carries a crew of one pilot and three electronic warfare officers. The new aircraft is in service with VAQ-129 Tactical Electronic Warfare Sqn at NAS Whidbey Island, Washington





Straight and Level



TWA pilots, *Interavia Air Letter* tells us, "have undertaken a voluntary programme to improve pilot performance, thereby helping TWA management to increase the carrier's earning power." The local chapters of Alpa, their union, are to administer the programme.

According to a message to members from Capt W. A. Murphey of Alpa, "any actions short of maximum effort in every area . . . can result in an exceedingly unwelcome change in our life style." He calls for an "increase in TWA pilot performance from 100 per cent to 110 per cent."

Just thought I'd mention it, in case there are still any of my Balpa nephews reading the old column on airway or fairway.

● The other week I reported a conversation I overheard in that most hallowed of British Service institutions, the United Services Club, concerning that most illustrious of British Servicemen, Lord Nelson.

Certain members of the club, whose doric columns now give hospitality to the Royal Aero Club, were aghast at rumours that the marble bust of Nelson was to be removed from its pride of place in the lobby, to make way for the Schneider Trophy.

I could hardly believe my eyes the other day when I saw that this substitution has in fact been accomplished, apparently without any scuffles. Follow that for hospitality.

● The new Civil Aviation Bill (yes, I too have an awful draft in the office) has a bit about airports in it, including some rules for the "waiting of hackney carriages."

Top Kneddy Get me a hackney carriage, serf, I wish to go to the London Flying Machines Drome.

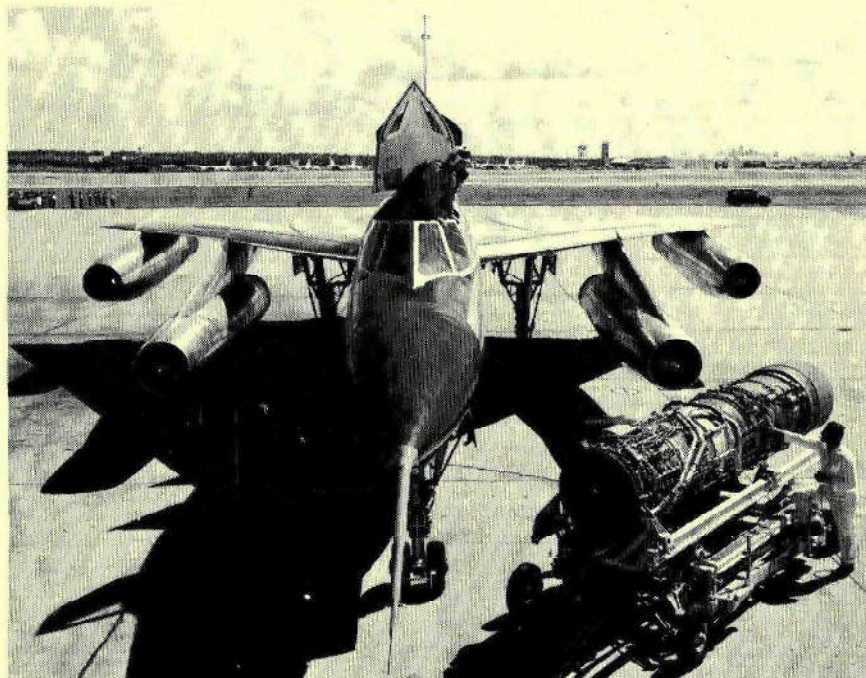
Bottom Neddy Certainly Sire, I will get you a radio cab right away.

Top Kneddy I would prefer one ordered by wireless telegraphy. Oh get on with it.

● "Some of you chaps look old enough to have designed the Spitfire. What's it feel like working in this office with a picture of Willi Messerschmitt on the wall?"

I didn't make a note of the exact words, but that was the gist of a question that BBC TV Panorama's Michael Charlton asked some BAC designers, most of them young, down at Munich on the telly the other night.

They told us what it was like working with the Germans, how it compared with working with the French, how one of their German colleagues had been shot down in a Ju 88 by a Spitfire, and we interviewed that



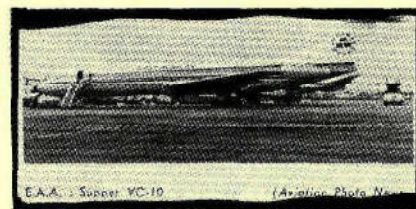
Sorry, no room for a fifth engine—try Hawker Siddeley Hatfield

agreeable and capable character Gero Madelung, Panavia's managing director.

It was a programme about Britain and Germany with particular reference to the Common Market. The MRCA was described as "Europe's biggest industrial programme, bigger even than the Concorde."

I would like to thank Michael Charlton, who made a name for himself with his Concorde programme last year, and the BBC editors concerned. The chaps who are doing aviation work are as important to the future of our country as Mary Gasring, trade union leaders, and all those chaps who

They couldn't find a 4lb bird



E.A.A. Super VC-10

(Aviation Photo News)

From "Air Afrique Information"

say I dunno David, I just sort of put me foot out like, yunno, and it was in the back of the net, yunno. Above all, aviation technology fulfils the ultimate contemporary criterion: it can make very interesting television.

● I've got an amendment to the Bill. Substitute for the words Secretary of State, wherever they appear in the Bill, the words "those ruddy civil servants."

But they are such terribly nice chaps.

● I'm doing my best to keep up with all these various ways of taking off and landing—Vtol, Stoll, Qtol (quiet) and Rtoll (restricted). But what's this Dettol?

Mr Henry Marking, chairman of BEA, was heard the other day to suggest it for clean take-off and landing.

Roger Bacon



PRESS DAY — Classified Advertisements "copy" should reach Head Office by **FIRST POST THURSDAY** for publication in the following week's issue subject to space being available

CLASSIFIED ADVERTISEMENTS

Advertisement Rates 12½p. (2/6) per word, minimum £1.50. (£110.0.). Paragraph is charged separately, name and address must be counted. Semi-display advertisements £9.50. (£910.0) per inch depth. All advertisements together with remittance should be addressed to **FLIGHT International Classified Advertisements Dept.**, Dorset House, Stamford Street, London, S.E.1. Telephone 01-928 3333. Telegrams/Telex **Bisnespres Ldn**, 25137.

Postal Orders and cheques sent in payment for advertisements should be made payable to **FLIGHT International**, and crossed " & Co".

Trade Advertisers who use these columns regularly are allowed a discount of 5% for 13, 10% for 26 and 15% for 52 consecutive insertion orders. Full particulars will be sent on application.

Box Numbers For the convenience of private advertisers, Box Number facilities are available at an additional charge of 4 words plus 10p. extra to defray the cost of registration and postage, which must be added to the advertisement charge. Replies should be addressed to Box 0000, c/o **FLIGHT International**, Dorset House Stamford Street, London, S.E.1.

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Aircraft For Sale

BRAND NEW F337, Fully equipped, full warranty. £34,000.

New 210, 57hr, airways equipped. £19,500.

Brand new F172H. Full warranty. £6,450.

1970 172, 250hr, nav./com., with VOR/LOC. Ind.,

ADF. £6,950.

1968 172 Dual. VHF/ILS/GS/MB/ADF. Nil engine

hours. £5,700.

Brand new 150, VHF/VOR. £6,500.

1966 337 Dual. VHF/VOR/ILS/GS/ADF/DME/MB.

£17,500.

1960 Piper Super Cub. VHF. £2,000.

NORTH AIR AVIATION,

LEEDS/BRADFORD AIRPORT,

YORKS.

Rawdon 2251.

[0153]

CESSNA F172, 180hr only; two 300 Cessna, VHF/VOR/LOC, Cessna ADF, marker beacons, C of A till April 1973. Many other extras. £7,850. Part-exchange considered. Perry, T. & T. House, Portsmouth Road, Cobham, Surrey, Tel: Cobham 4493. [0190]

1965 AZTEC C, New C of A, airways radio, 2-axis

A/P. £15,750. Gen-Avia Ltd, Alexandra House, Alex-

andra Terrace, Guildford, Surrey. Tel: Guildford 60061.

[0750]

CESSNA 337, 1970, ADF 300 with BFO, Cessna nav./com., 400, VHF/VOR/LOC, Glideslope, King KX160, K1301 VHF/VOR/LOC, King KMA12 marker, rec. and audio, King KT75R and King KN60B, OME, usual accessories, de-icing wings, tailplane and front

prop.; 6 seats, 300hr.

CESSNA F172H, Company plane, 1969; 500hr since

new, VHF/VOR/ADF/Marker, Corrosion proofed. Write

or telephone Mr G. Payne, Building Design Partner-

ship, Vernon Street, Moor Lane, Preston PR1 3PQ.

Telephone Preston 57794. [0971]

TURBO TWIN COMANCHE B, G-AVT1, As-new condi-

tion. One Narco Mk. 12, one Mk. 24, Glideslope, DME,

Transponder, GARM1, radio couplers, auto-pilot,

markers, Private sale, with new C of A. Tel: 01-953

1464, or 01-903 1658. [3135]

HORIZON 160, Retractable, VP propeller, Bendix

VHF, King VHF/VOR, total time 428. Part-exchange

considered for Comanche or similar. Cash adjustment.

Telephone Cleethorpes 61329 (evenings). [3130]

1969 BEECHCRAFT MUSKATEER, fully equipped, VHF/VOR/ADF, only 120hr since new. Immaculate condition. £7,980. Glos-Air Ltd, Staverton Airport, Glos., Tel. Churchdown 3385/2579. [0612]

PIPER TURBO NAVAJO, 424 TT, G-AVSE, new C of

A, props 24hr, commutator/executive interior, 8 seats,

fully IFR equipped. Full de-icing, Altimatec III with

couplers, oxygen, toilet. £46,000. Drumbard Ltd., 140

Abbey House, Victoria Street, London, S.W.1. Tel.

01-222 6111. [0611]

MUSKATEER CUSTOM, 180hp., 1970 manufacture.

VHF/VOR/LOC, ADF, night flying, 175hr TT, 140

m.d.h., 860 mile range, 4 seater+270lb, impeccable

condition. £9,750. Home-Bramley 3482. Office-Wes-

bridge 48344. [3136]

SHACKLETON AVIATION LTD. ESTABLISHED 1930

THE LARGEST AND BEST KNOWN AIRCRAFT DEALERS IN THE WORLD

FINANCING VALUATIONS INSURANCE

FOR OVERSEAS CUSTOMERS AS WELL AS FOR THOSE AT HOME WE ARE ABLE TO OFFER FULL FINANCE ON SECOND-HAND OR NEW LIGHT AIRCRAFT WHICH ARE PURCHASED FROM US.

WE ARE PLEASED TO ADVISE YOU ON THE RIGHT TYPE OF AIRCRAFT FOR YOUR JOB.

LIGHT TWIN AIRCRAFT

Turbo Aero Commander 680V, Only 740 hours since new. Fully pressurised, 8 seats, Bendix Autopilot, Full airways radio, also Sunair H.F. and Radar, A high-class company aircraft.

Cessna 310, For people seeking a reasonably priced Twin aircraft we can offer a CESSNA 310 with fully de-iced airframe and propellers, Full IFR radio, Current C of A, Engine TSO's 386 and 1078; propeller TSO's 700 and 656 hours. Completely resprayed and in good order throughout. Only £7,950!

Piper Aztec C, 6 seats, Full IFR, Autopilot, Rotating beacon, Dual Narco Mk. 12 VHF/VOR-ILS, Bendix ADF, Sunair H.F. Markers, Maintained regardless of cost. £15,750.

Beagle 206, Built 1966, 7 seats, New C of A, Full de-icing, Sperry 3 Axis Autopilot, Airways radio, Good company aircraft. £12,500.

Piper Twin Comanche, Built 1967, 6 seats, New C of A, Long range tip tanks, Autopilot, Rotating beacon, Airways radio, In good order throughout, £11,000. (Just in not previously advertised)

ALSO: Further Cessna 310 D.H. Dove Super Aero 45 Details on application.

TRANSPORT AIRCRAFT AVAILABLE

NOTE: On all the aircraft listed below we can provide full finance

TWO

HAWKER SIDDELEY TRIDENT 1E's

Spare Engines and Spares

inventory. A complete

package transaction.

Offered at a special new

price of £2,600,000 complete.

ONE BRISTOL BRITANNIA 312 SERIES AIRCRAFT

available with Freight door

FOUR F.27 100 SERIES AIRCRAFT

immediately available and in

good order.

450,000 U.S. dollars each.

OUR SPARES DEPARTMENT CAN OFFER AN EXCELLENT SERVICE SUPPLYING BAC 1-11 AND BOEING SPARE PARTS. ALSO EXTENSIVE AVIONICS EQUIPMENT.

Cessna 172H, Very well equipped with DME Navematic autopilot, King VHF/VOR-ILS also 2nd VHF/VOR, Cessna 300 ADF, Only 704 hours since new, C of A until June 1972. Metallic blue interior, white and blue exterior. Full dual controls, blind flying panel, night flying equipment, rotating beacon, Twin altimeters. £7,750.

BEAGLE PUP 121, Built 1968, 2 seats, Current Club C of A, Dual controls, night flying equipment, VHF/VOR Bendix, Intercom, 776 hours remaining on engine. An excellent buy at only £2,950. (Scottish Aviation are providing a spares back-up on all Pup Aircraft.)

So you want your first aeroplane and don't wish to spend a fortune!

We can recommend our latest **AUSTER** (JUST IN 3rd April):

Auster 5J1, 3 seats, C of A until February 1974, (completely re-fabricated February 1971, Engine TSO 670, Generator, full dual controls, Plessey radio, An exceptionally clean Auster. £875

SINGLE-ENGINED AIRCRAFT

Bolkow Junior	£1,750	Cessna 172H	£5,000
Citabria	£5,250	Super Rallye	£3,250
Chipmunk 22A	£1,750	Cessna 172E	£5,000
Scintex Emerald	£1,500	Nipper Mk. III	£1,375
Piel Emerald	£1,500	Cessna 210	£8,250
Falco P8L	£3,950	Beagle Aldale	£2,450
Ereospe	£1,350	Meta Sokol	£2,750
Cessna 150	£3,250	Tiger Moth	£1,650
Siampe	£1,750	Beagle Aldale	£2,250
Victa Airtourer	£3,250	Helio Super Courier	£5,750
Cessna 172H	£8,950	Piper Tri-pacer 160	£1,850
Jodel D140A	£3,800	Sai Marchetti S205	£5,000
Sai Marchetti S205	£7,000	Cessna 172H	£5,000
Beagle Pup	£2,800	Jodel	£1,850
S205 Marchetti	£5,750		

Helicopter

Brantly 305, Only 384 hours since new £7,900

HEAD OFFICE: 170-3 PICCADILLY, LONDON W.1. Tel.: 01-493 2448 Telex: 263975

PART EXCHANGE SOLE AGENCY