RAF TRANSPORT COMMAND REVIEW

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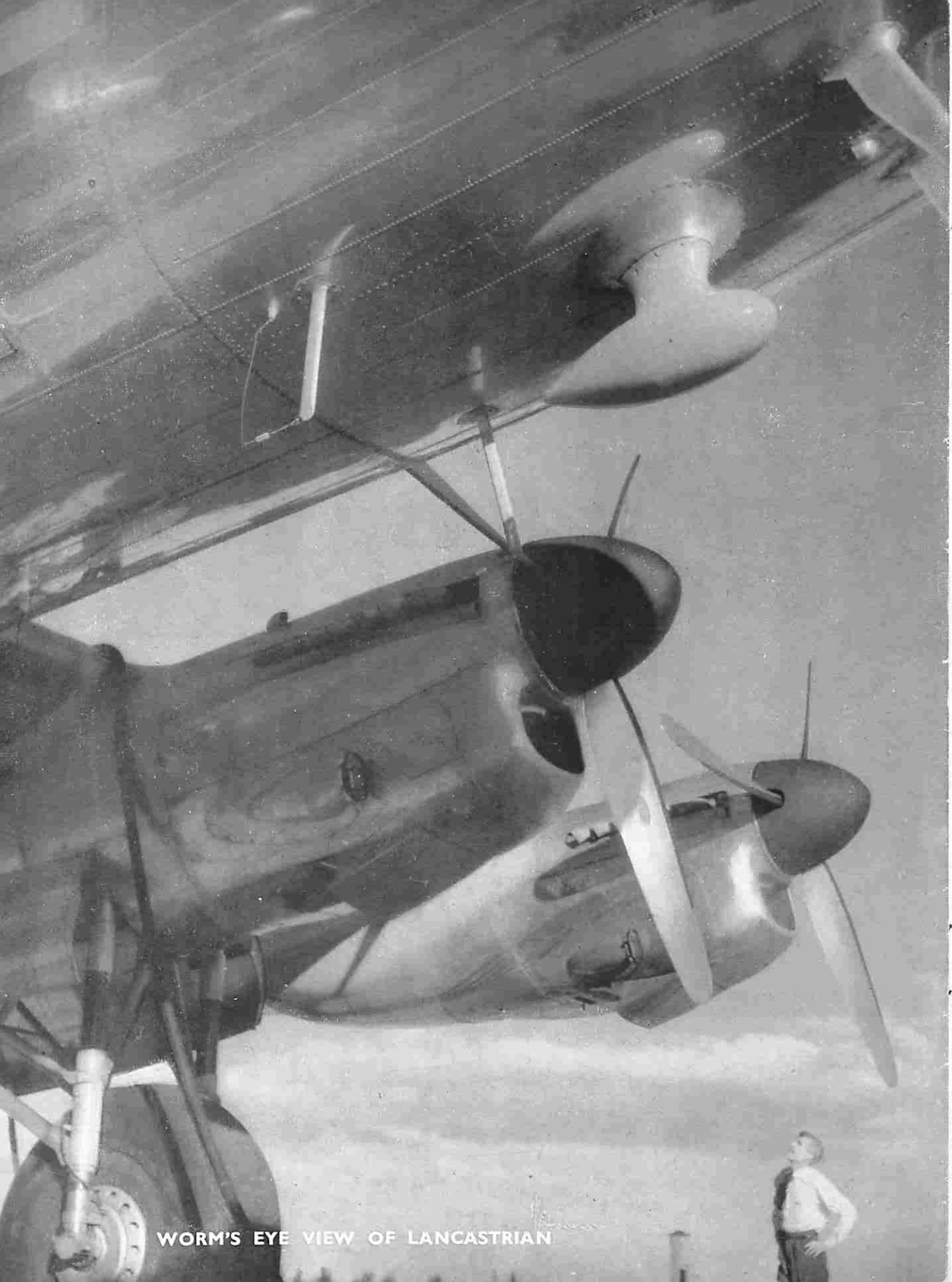

WORM'S EYE VIEW OF LANCASTRIAN

TRANSPORT COMMAND REVIEW

ISSUED BY H Q TRANSPORT COMMAND
ROYAL AIR FORCE

No. 9 MAY 1946

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An Approach to the Problem of ASYMMETRIC FLYING

Prepared by the Empire Central Flying School

THIS article does not profess to be a scientific treatise. It is rather a suggested briefing, such as an instructor might give his pupil before demonstrating any exercise involving asymmetric powered flight.

The problem under consideration is that of flying a twin engine aircraft on one engine, or a four engine aircraft on two engines on one side. The principles involved are the same in both cases, and to avoid repetition, everything is written here as for the twin engine machine. Flying a four engine aircraft on any three engines presents no special problem, and any points which may arise are amply covered by an understanding of the major problem, which is flying on two engines on one side.

The first point—in fact the "be all and end all" of asymmetric power flying—is a complete knowledge of the meaning and scope of critical speeds. Perhaps we should start with a definition of critical speed. It is "*that speed below which the aircraft cannot be kept directionally straight with the rudder.*" Now, for any particular aircraft, there is an almost infinitely variable range of critical speeds, depending upon a great variety of conditions, such as power, height, load, weather conditions, conditions of the failed engine, and last, but by no means least, the pilot. The highest critical speed will be when the aircraft has maximum power (*i.e.* full boost and maximum r.p.m.) on one engine, while the failed engine is windmilling at maximum r.p.m. The obvious instance when this is likely to occur is an engine failure on take off.

It is never possible to define accurately the critical speed of an aircraft to anyone but yourself, as in the extreme case the critical speed may become a matter of the pilot's own physical strength. It will also vary among different aircraft of the same type and mark.

A pilot can only be told an approximate critical speed for any particular aircraft, and must himself find out his own particular ability to master the aircraft in extreme conditions on one engine. If the pilot finds a speed at which he can with the rudder maintain the aircraft straight on one engine, keeping full power on the live engine, and the dead engine windmilling at maximum r.p.m., he has the satisfaction of knowing that with any less power on the "live" engine, or with the propeller feathered on the failed engine, his critical speed will be lower.

Finding the critical speed is a very simple and straightforward process. Take the aircraft to a safe height, fail an engine, apply as much trim as is available, or as is required to relieve the foot load, and then gradually decrease the airspeed by easing the stick back slowly. As the airspeed decreases, notice that progressively more foot load is required on the rudder to keep the aircraft straight and, watching the directional gyro or any other suitable point, a speed will be reached where it is no longer possible, even with full trim and maximum physical effort on the rudder, to keep the aircraft straight. The moment the aircraft starts to yaw, that airspeed is your critical speed for the particular set of conditions prevailing. This yaw is marked at once by the slip indicator moving from the central position. The yaw is accompanied by the old familiar symptoms: by the aircraft taking on bank as the yaw increases, followed by the nose dropping. Recovery is effected either by pushing the stick forward to increase the airspeed or by throttling back the live engine, or doing both.

This exercise of finding critical speed should be repeated under varying conditions of power on the live engine, and with the aircraft itself in varying conditions, such as undercarriage down, undercarriage and flaps down, flaps down only, and so on, until the pilot is quite happy that he knows exactly what speed is required to keep that aircraft straight with full rudder at different power settings and in any particular conditions of flight.

Two vitally important conditions should have become apparent by now: the first is that all the time the pilot is maintaining directional control, the slip indicator can be kept in the centre. The second is that the power used on the live engine is the chief factor affecting the critical speed.

It cannot be too strongly stressed that the slip indicator is of paramount importance when flying on asymmetric power. If the aircraft can be kept directionally straight by using the rudder only, then no attempt should be made to ease the foot load by applying bank. Although this is the easier way, it means that the aircraft will be slipping in, and therefore flying inefficiently. Just how much inefficiency due to slip does actually affect the aircraft's single engine performance varies considerably with aircraft types. This does not detract from the principle that slip does mar the performance, and therefore should be avoided even at the expense of greater physical effort on the part of the pilot. However, in dire emergency, with the aircraft below its critical speed, no holds are barred and it may be that the pilot has to apply full rudder and aileron in an endeavour to counteract yaw and bank, while an attempt is made to regain critical speed. (Incidentally, with an aircraft of a large wingspan and at slow speed, if the pilot applies bank in an endeavour to check yaw, he may, in actual fact, aggravate the yaw due to the malicious work of aileron drag.)

Keep the slip indicator central. All the time you can keep it in the centre it means that you have fully compensated the yaw caused by the dead engine and the power on the live engine ; therefore, you have the aircraft under control. If the slip indicator moves from the centre because the aircraft has got below critical speed, then you must either throttle back the live engine, or regain airspeed by diving, or do both together. It is important to remember that when flying on one engine, if the aircraft is below its critical speed, speed cannot be regained by opening the throttle of the live engine. This merely raises the critical speed, thus making the yaw worse. The only remedy is to push the control column forward.

Summing up, the slip indicator should be kept in the centre under all conditions of flight on one engine. If this is done, any manoeuvre that can normally be executed by the aircraft on all engines, can be executed on one, and the old tale that a turn with the live engine on top was the prelude to an uncontrolled yaw and a sticky end, is untrue. For any manoeuvres on one engine the airspeed must be at least the same speed as the pilot would use for the same manoeuvre on two engines, *and the slip indicator must be in the centre.* In certain manoeuvres, such as steep turns, it may not be possible on all aircraft to maintain the required speed with the power of one engine; in these cases it will be necessary to lose height in order to maintain the correct airspeed.

So much for handling the aircraft in the air. The next point which interests most pilots, when faced with an engine failure, is how they are placed for landing.

The easiest approach to judge is the normal powered approach where, by judicious use of throttles, the pilot should be able to position the aircraft at the correct height over the end of the runway and at the required airspeed; and the most difficult approach in which to fulfil these conditions is the glide approach. Why, then, do pilots so often try to carry out the type of approach which is most difficult to judge when an engine has failed? Why not use the admittedly easier, engine assisted approach?

If the pilot has by now tried the critical speeds of the aircraft, he should know what speed he must maintain so that he can use the required power, in order either to maintain height, or lose the least possible height with undercarriage down and, perhaps, 20 degrees of flap. If he knows this speed, he then knows that if he maintains this speed he can make a normal engine assisted approach, because by decreasing his power he can reduce height and, provided he keeps his airspeed correct, he can, if necessary, use maximum power for this airspeed to check his decrease of height, thus stretching his approach.

Take the case of the average modern aircraft, with undercarriage down and 20 degrees of flap ; the pilot should be able to keep his rate of descent as low as 200 feet per minute without difficulty. This means that if he is making his circuit at 1,000 feet above the ground he will have five minutes after his undercarriage and flaps are lowered on the downwind leg—and five minutes is a long time for making his final approach.

A knowledge of critical speeds does not mean that you can descend to ground level several miles downwind of your airfield, and then motor in on one engine, but it does mean that you can greatly prolong your approach, provided your aircraft will maintain height on one engine indefinitely, or lose height at 200 feet a minute for five minutes. It therefore seems the wisest policy to do your single engine circuit at the same height above the ground and the same distance from the airfield as you would use in those same conditions if you had both engines.

As regards the handling of the ancillary equipment —undercarriage and flaps—these can often be used on single engine landings in exactly the same way as with both engines, but their effect varies so much with each type of aircraft that no firm rule can be made on this point.

If the aircraft is fitted with a trimming tab on the rudder, leave on the trim throughout the approach. This will be of great assistance when using the live engine, and in the event of an overshoot. As the trim becomes ineffective at low airspeeds, its tendency to cause a swing on landing is negligible.

To carry out the single engine approach and landing, the pilot should, then, continue round the circuit in the normal way, and then complete his final turn in. In this position the height normally is 600/800 feet, and at that stage the pilot must make a decision—whether he is going to land off that approach or whether he is going to overshoot, and have another try. If he decides to go in, he should then apply the rest of his flap and motor in, decreasing power as height and speed are lost.

There are aircraft which will overshoot from ground level on one engine with the undercarriage and flaps fully down, but, as a general rule, when you have completed your final turn in and, if you have applied full flap, it is better to make the decision not to attempt to go round again.

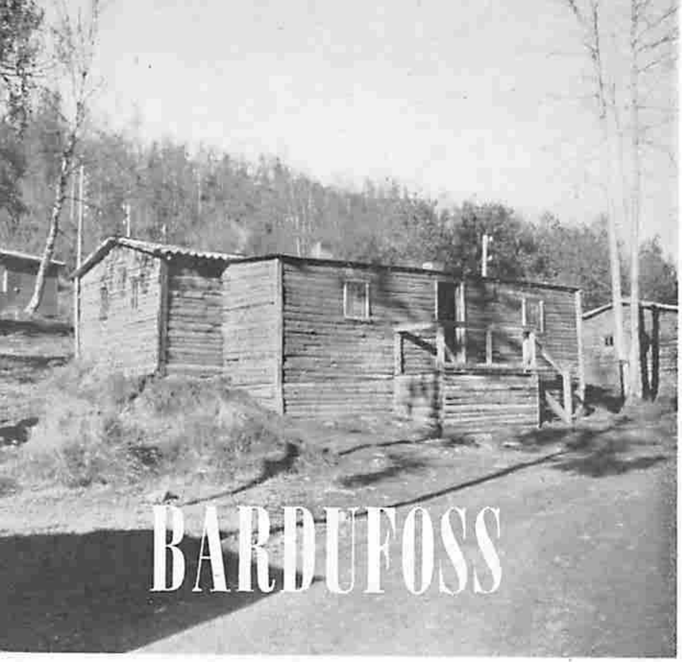
Overshoot action is quite straightforward if the aircraft will climb on one engine. Once again, you must maintain the correct speed to enable you to use full power on the "live" engine. Open the throttle of the live engine fully, and then, depending upon the aircraft type, select undercarriage and then flaps up, or vice versa, or both undercarriage and flaps up together, in order to reduce the most drag in the least time.

It is necessary to use will power and act against your natural instincts. Your natural desire will be to lose as little height as possible, but remember that height means that you are able to increase airspeed by diving, and the faster you fly the more power you can put on your live engine, the less will be the drag from your rudder, and therefore the better will be your climb away finally. So, open the throttle, keeping the airspeed at or above that speed at which you can hold the aircraft straight with full throttle. If your speed starts to drop off, push the nose down. It is better to be at 50 feet under full control than at 500 feet with full power, causing an uncontrollable yaw. As soon as the undercarriage and flaps go up you will notice the aircraft begin to accelerate, then you can start to climb away. This is a very easy manoeuvre to practise. Try it out at a safe height, using the altimeter as a guide, and see how little height you can lose while doing an overshoot.

If you become happy and confident in this practice, a single engine landing should hold no fears because, if the aircraft will overshoot on one engine with undercarriage and flaps down, it will be a very easy job to motor in on one engine.

Regarding the effect of flaps on critical speeds, on some types of aircraft the critical speed is lowered by applying a certain amount of flap; on some it has little effect, on others it raises the critical speed. Therefore, again, the pilot must find out for himself how his aircraft reacts to the application of flap. The effect of load on critical speed is fairly straightforward. The heavier the load, the more power required to maintain any given height and speed, and therefore you may not be able to maintain height on one engine. But remember that it is speed of air over the rudder which makes the rudder effective, and gives you your directional control. If you keep your speed, you can maintain control whatever the load, although you may not have sufficient power on one engine to maintain height. In this case throw everything possible overboard. Remember, too, that height affects the performance of the engine and it may not be possible to maintain height on one engine at high altitude, but quite possible when you descend to full throttle height. Also, get rid of all unnecessary drag. The more drag there is, the slower the airspeed for any particular power setting.

Finally, although single engine landing with the propeller of the dead engine windmilling is necessary as a practice in itself, *don't* imagine that this can ever replace practice landings with a propeller feathered. If you do, you are fooling yourself, and you know it. As long as you can open up both engines if you make an error, the practice is no good, and the psychological effect of having a stationary propeller cannot be overlooked. The performance of the aircraft is very different. The drag of the windmilling propeller, and the fact that your hydraulic services work in a different manner, and at different speed with both engines going—all these points deceive you.



BARDUFOSS

FLIGHT LIEUTENANT K. S. KING

"WHERE'S Bardufoss?" I was posted there and I wanted to know.

They showed me a huge map of Norway on the wall and there, up near the ceiling, was a small, yellow pin. That was Bardufoss, the most northerly Staging Post in Transport Command. There wasn't a town within 90 miles; the Arctic Circle lay 200 miles to the *South;* Oslo was 700 miles south. Did you know Norway was so long?

Bardufoss had been one of the main aerodromes from which the Germans mounted their air attacks on our convoys to Russia. There was one concrete runway, some 1,800 yards long, at the junction of two valleys, and surrounded by high mountains.

Our occupation of this northerly post in the early summer of 1945 was more by courtesy of the Luftwaffe than by force of arms, for throughout the whole of northern Norway there was a handful of British troops among 176,000 Germans, and the German officers still carried arms. After the removal of obstructive individuals, the Germans continued to operate the airfield under British supervision. Signals and navigational aids, for instance, were entirely operated by Germans. Flying Control consisted of one officer, a sergeant and Luftwaffe telephonists and clerks. In the cookhouse, the RAF kitchen staff exercised a rather idle, but good-natured despotism over the Luftwaffe men, who carried out all the menial tasks. Germans marshalled the aircraft, manned the crash tender, did the refuelling and drove the goats off the runway.

And not only were there goats. Norwegians from the neighbouring hamlet rejoiced in their new freedom by using the runway as a main thoroughfare and meeting place and for trying out their cars, just released from the German MT dump. Finally, local Resistance Guards were posted at strategic points. They used their rifles with enthusiasm and without discrimination. But no one succeeded in stopping a herd of cows which crossed in their own time promptly at 1600 hours daily.

The work of the Staging Post was confined to handling the Dakota services, which carried passengers and mail to and from Oslo three times a week, and two Sunderlands flying between Bardufoss and Tromso. The traffic was always heavy, for the only other means of reaching civilisation was by rail, through Sweden, or by a sea journey which took a week. Most of the high-ranking officers in Allied Forces Norway passed through the Staging Post, and several notorious German figures, too. General Jodl, enemy Commander-in-Chief in the north, was asked to state his religion before emplaning. He answered Protestant. The traffic corporal scratched his head and wrote "Church of England" on the manifest!

During July and August the days at Bardufoss were brilliant and the sun shone almost till midnight; mosquitoes were features we had not expected to find in the Arctic Circle. But in the middle of September, the frosts began. Each morning the snow line was noticeably lower down the mountains. Then the airfield was closed for days of rain and sleet. The roads, never good, broke up and the 90 mile drive to Tromso for rations frequently took three days and involved three old German lorries. It was welcome news when we learned that the Staging Post was to be withdrawn.

At the first break in the weather, two Dakotas arrived, followed immediately by the heaviest fall of snow. They left in a grey dawn, crammed with passengers and freight. Next day, five Dakotas reached the area but had to circle for ninety minutes off the Lofotens before they could get in to land. With their departure there was no doubt in the minds of those left behind that the only way out was overland.

In decrepit lorries the party straggled over the mountains to Narvik, boarded a train and reached the Swedish frontier. Our hardships were now over. The 36-hour journey to Oslo gave us our first glimpse for five years of a country untouched by war.

Bardufoss, on the morning of the departure of the last RAF Dakotas to reach the airfield

Please save a place for

THE FLIGHT ENGINEER

A. F. BEEVERS

THE rapid introduction of Flight Engineers into the Royal Air Force gave little time for their organisation on a sound basis for carrying them into the future. Opinion as to their necessity has been so divided that one of the first peacetime transport aircraft, although equipped with an engineer's panel, provides no crew position, and consequently the log has to be kept wherever the flight engineer can find a place to sit. To-day, with the large-scale introduction of mechanical aids, the future of the flight engineer is firmly assured, and he is as certain to remain to watch the conditions of the aircraft in flight, as stewards will watch over the well-being of passengers.

Although we have now parted from the days of battle, the basic training of the flight engineer in the Royal Air Force must be such as to equip him for duties in peace and war, and therefore is bound to differ from that of his civil counterpart. The flight engineer's duties during the war were mainly divided between keeping a log sheet and assisting the crew during action. It was inevitable that the aircraft spent a great portion of its time on the ground at base, and the ground staff were intimately familiar with its history. But these conditions cannot apply under present high intensity operation in Transport Command, where aircraft are grounded for relatively short periods at any one aerodrome for servicing requirements. The continuous demand for higher intensity in operations calls for greater serviceability, and means that the duties of a flight engineer will assume even greater importance.

What are the qualifications and training required for these duties ?

During the war years the direct entries made a very good impression in this field, but it must be agreed that the scope in the future is so wide that the trained engineer is bound to be in a better position to absorb the increasing amount of technical data.

Transport Command naturally attaches special importance to these qualifications. On entry into the Command, the flight engineer attends a preliminary course at Snaith, during which he is made familiar with the working of engine types in operational use. Then he goes through a Heavy Conversion Unit (Flight Engineers') Course either at Dishforth (for Yorks) or at Linton-on-Ouse (for Halifaxes). This course gives him a thorough understanding of servicing procedures and introduces him to the all-important subject of engine handling. After rejoining the Squadron he will, before long, be sent to one or other of the courses provided by the manufacturers in association with Technical Training Command. These courses provide advanced training in engine servicing, engine handling, or airframe servicing, and are invaluable to the development of a really efficient flight engineer. Back on his Squadron, the flight engineer is given continuation training. He is attached to the Servicing Wing at his base for a short period every three months; during these periods he will assist in certain maintenance tasks and actually carry out some servicing tasks on his own. If the flight engineer still has time to spare at his base, the Flight Engineer Leader

(a flight engineer who supervises local technical training under the Squadron Commander) will arrange lectures and carry out periodic checks on his log keeping.

The results of all this, of course, become apparent in the six-monthly Categorisations which all flight engineers, in common with other flying crew members, must undergo.

In the course of operations the flight engineer will have plenty of occasion to bless his exhaustive and thorough training.

Suppose his aircraft, on a long stage of trunk route flying, develops some engine trouble. At the first stop he contacts the engineer in charge of the servicing party. An accurate and concise description of symptoms will be of very real assistance to the ground staff who will have to remedy the defects; probably, if his training has had effect, he will be able to make a knowledgeable suggestion as to the diagnosis of the trouble. In any case, he makes sure that they understand the defects which developed in flight, and he answers as clearly and methodically as possible any questions the ground crew may ask. Servicing, rectification of defects, refuelling and unloading begin, and the rest of the crew depart to fulfil their duties. Although this crew has been in the air for a long period, and will undoubtedly be ready for some sleep, it is essential that the flight engineer remains and advises the servicing party until such time as all the troubles he has encountered have either been dealt with, or are receiving competent attention.

During this time, if a new crew is being "slipped" at this point, the flight engineer who will take the aircraft on to the next Staging Post reports and talks over the last trip with the engineer going off duty. The new flight engineer then carries out his routine checks and in the shortest possible time the aircraft should be on its way.

A flight engineer's duties are not entirely confined to the maintenance of engines and aircraft. His capacity as adviser to the pilot demands that special knowledge of engine handling to which much of his training was devoted. This aspect cannot be overemphasised. Incorrect handling can reduce the over-all life of the engine to such a low level that no high intensity operation could be maintained. A flight engineer who is, in every sense of the word, a true engineer will be twice as valuable to the RAF, and in particular to his own crew, as one who leaves most of the troubles to the ground staff. Thus, if need be, the flight engineer should be capable of carrying out all the engine and aircraft servicing necessary along the route.

All this will probably make the flight engineer decide that life is a bit hard, and wish he had selected some other trade at the moment of choice. It is, however, the only way to success, and it is entirely up to him to make his position mean what the designation of his title implies.

In due course he will get to know, and make friends among, the personnel at each Staging Post at which he calls. He will come to like the responsibility of diagnosing faults in the air, and find satisfaction in the assistance he is able to give the hard-working ground crews. He will also get an intimate knowledge of his aircraft type while assisting the servicing crews during inspection, a knowledge which he can obtain in no other way. This knowledge and experience will rapidly transform his ideas into suggestions valued for the time and labour which they save. He will also be able to rectify some of those trifling things which unnecessarily delay take-offs, and are so annoying to passengers and ground staff.

In conclusion it would be as well to reflect that many Service flight engineers will perhaps perform similar functions in civil aviation. While the requirements are fundamentally similar, in civil operations more emphasis is laid upon the economy aspect for obvious reasons. Whereas the overriding requirements for military aircraft are reliability and high performance, civil aircraft must provide extreme reliability coupled with really long and intensive service, at the minimum operating cost—if necessary at the sacrifice of high performance at a high speed. The speed itself may quite probably be sacrificed at the design stage, especially where freighter aircraft are concerned, if by so doing the probable length of trouble-free service between inspections, changes of components, and extension of engine life can be considerably increased.

To emphasise all this yet further, we must consider that a particular aircraft is being employed as a commercial proposition. The fees collected for the carriage of freight and/or passengers must pay, among many other things, for the spares and fuel used by the aeroplane, for the insurance cover, and the capital required to purchase the machine, and for the wages of the ground staff and air crew. In order to collect sufficient fees to pay for all these items, the aircraft cannot be allowed to remain on the ground for long periods. The flying hours per day for each aircraft on strength must be far in excess of any yet recorded in this country, and the man-hours for servicing must be reduced considerably by better planning of inspections. Ideally, an aircraft would be on the ground between flights only whilst unloading and re-loading takes place, the time allowed for servicing and refuelling being taken during this same period.

It will be seen, therefore, that the contribution which the flight engineer can make towards the efficient operation of the aircraft is very considerable. With his training and particular knowledge of the aircraft he could prevent a certain amount of unserviceability. By intelligent anticipation he could reduce to the minimum the time taken to remedy defects which might occur. Only by such keen and knowledgeable attention will it be possible to maintain the high standard of operating efficiency that will be called for in this new era.

REBECCA

BABS

The Editor's footnote reference in the April issue of the REVIEW *to the Rebecca/Babs Training Flight at Melbourne stimulated two contributions to describe the BABS equipment and procedure. This article is therefore a joint description by* SQUADRON LEADER K. G. PRICE, D.F.C., *of Flying Control Branch at Headquarters, and* SQUADRON LEADER D. J. B. CROSS, A.F.C., *Officer Commanding*, 1510 *Flight, Melbourne.*

IN last month's TRANSPORT COMMAND REVIEW, GCA or Ground Controlled Approach, was described. This article is to tell you about BABS, another radar approach aid for conditions of poor visibility, but this time all the work is done in the aircraft.

There are four factors involved in the operation of BABS (Beam Approach Beacon System); the BABS Beacon on the airfield, a Rebecca set in the aircraft, the pilot and the navigator.

The beacon consists of a mobile transmitting van installed beyond the upwind end of the runway which radiates pulses of energy at a predetermined frequency in two divergent beams. The van is so aligned that the beams diverge symmetrically about each side of the runway and overlap by the width of the runway at the touch-down point. One of the beams transmits short dot pulses, the other transmits dash pulses. Where the two beams overlap down the centre of the runway the dots and dashes are equal; this is the equi-signal zone.

When an aircraft transmits its interrogation signal, the response from the BABS beacon is displayed to the navigator on the Plan Position Indicator of the Rebecca set. The dot signals are represented as a thin blip, the dashes as a *fat* blip; the one is superimposed on the other. The fatness and thinness of the two blips remains constant so there is no difficulty in distinguishing between dot and dash. But the *amplitudes* of the two blips vary in relation to each other as the aircraft approaches or departs from the equi-signal zone.

From the navigator's or pilot's point of view, the dot signals are predominant when the aircraft is in the area to port of the true approach, the dash signals are predominant to starboard. If the aircraft is approaching in line with the runway, it will be in the equi-signal zone and the blips on the PPI will be of equal amplitude.

The ratio between the amplitude of one blip and the other is determined by the radiation (fan pattern) of the beacon and it is possible for the navigator to determine which part of the BABS beam he is in by considering the ratios of the two blips. The equi-signal zone covers an arc of only 1·3 degrees, and the approximate ratios are:

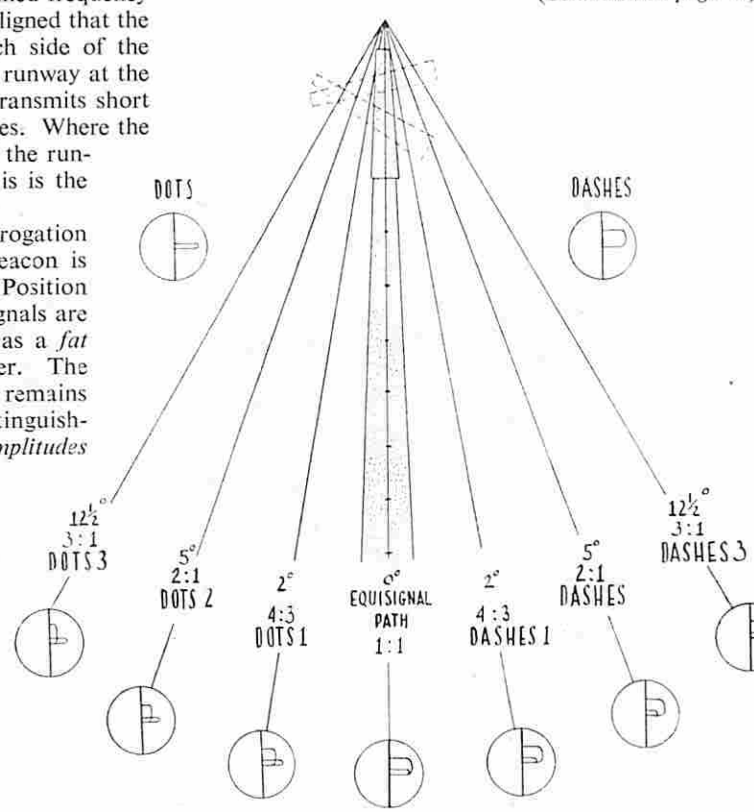
4 : 4 along the extended centre of runway,
4 : 3 at 2 degrees off centre,
2 : 1 at 5 degrees off centre,
3 : 1 at 12½ degrees off centre.

The indications of bearing in azimuth may be interpreted to an accuracy of $\pm \frac{1}{2}$ degree to $\pm \frac{1}{4}$ degree, and a skilled operator can distinguish one side of the runway from the other at a distance of a mile.

As with other radar systems, of course, the range of the aircraft from the BABS beacon is also progressively indicated. The bottom of the two blips as seen on the PPI are coincident and a green trace, calibrated in nautical miles on the cathode ray tube, enables the distance to be read off instantly.

In Transport Command the procedure for a BABS approach is for the navigator to pass information to the pilot and a standard patter is followed. If at 4 miles the ratio of the blips was 3 : 1 he would say: "*Dots* (*or dashes*) 3—*Four miles.*" If the ratio was 2 : 1: "*Dots* (*or dashes*) 2—*Four miles.*" If one blip is only slightly longer than the other he would say: "*Slight dots* (*or dashes*)—*Four miles.*" In the equi-signal zone the word "*steady*" is used, again followed by the range.

(*Continued on page 11*)



SPECIAL FLIGHTS

FLIGHT-LIEUTENANT J. M. COLEY.

In addition to the many scheduled services and trooping commitments still operated by Transport Command, there are numerous other demands for air transport which cannot be met through normal channels. These fall under the heading of Special Flights.

The majority of these flights are sponsored by Government Departments, who approach Air Ministry through a branch known as Movements 7A. Their applications may include requests for flights of either passengers or freight to any part of the world.

As a general rule, special flights are only arranged if normal services are unable to meet the occasion. For instance, journeys demanding a special itinerary off the scheduled routes, a VIP staff tour of extended duration, or a flight of exceptional urgency—these are the usual circumstances for which special flights are arranged.

Once the need for a special flight has been sanctioned by Air Ministry, and financial approval has been obtained, Movements 7A pass the request to the Special Flights Section at Transport Command for action. Details of the load, including the number and names of passengers, or the type, size and weight of freight to be carried, are given. Quite often the required time of the flight, as well as the date, is specified. In addition, the places of departure and destination and any specified itinerary may be given.

When the flight has been undertaken by Headquarters, it is allotted a special flight number. The type of aircraft and the most suitable airfields near to the places of departure and destination are decided. The complete information is then passed in the form of a Booking to 46 Group, who control the Special Flights Squadrons.

Whereas a few months ago Headquarters used to delegate a special flight task to any one of its Groups, almost all special flights are now passed to 46 Group, and through them, carried out by 24 Squadron or 1359 Flight, both stationed at Bassingbourn, or by the Metropolitan Communications Squadron at Hendon. There are a few flights, mainly of an experimental or training nature, which are still operated by other Groups in the Command, but these are only delegated to a particular Group for purposes of warning, briefing and despatching.

46 Group have a Special Flights Section similar to the one at Headquarters, and they in turn pass the booking to either Bassingbourn or Hendon, who allot a particular aircraft and crew for the duty. The Group, however, are responsible for sending out a full itinerary signal to all stations, Groups and Area Headquarters concerned with the flight. It may also be necessary to obtain a clearance for the aircraft if it is to operate over country not under Allied control. This is done through Air Ministry, who signal the Air Attachés in the countries concerned.

The major, and indeed the most interesting, function of the special flights organisation is arranging and operating flights for persons classed as VIPs.

The crews employed on VIP flights—all drawn from either 24 Squadron or from 1359 Flight—are specially picked for their flying ability and efficiency, and must have a wide experience of transport flying. They may be called upon to operate through the extreme ranges of the world's climates and in areas where an intimate knowledge of prevailing conditions is indispensable. The captains of these aircraft must have at least 200 hours' experience on the type of aircraft which they are to fly and, of course, must pass the very stringent Transport Command Examination Board before they are categorised as VIP crews. In order to maintain a supply of crews of this high standard, special long-distance training flights are carried out about every three months. The recent flight to New Zealand by two Lancastrians (one of which set up a new record for the round trip) was an example of this training.

Unlike scheduled services, special flights may be of varying duration and so, although the aircraft are maintained on a progressive maintenance basis, inspections have to be carefully timed so that they cause the minimum delay.

The transport of the British emissaries and their advisers and staffs to the various Allied conferences has on many occasions been carried out by Transport Command. Examples include the flights of Mr. Churchill to the Yalta conference; Mr. Churchill, Mr. Attlee, Mr. Eden and Mr. Bevin to Potsdam; Mr. Attlee and Mr. Eden to San Francisco; and Mr. Bevin to Moscow.

When Sir Archibald Clarke-Kerr relinquished his post as British Ambassador in Moscow he was flown to England in a special Transport Command aircraft and then proceeded to Batavia *via* Russia to investigate the Indonesian disturbances. Another special flight to Batavia was arranged on the appointment of Lord Killearn as Special Commissioner for South-East Asia.

Sir Ben Smith travelled to Washington for a food conference early in March this year in one of the last Skymaster aircraft to be returned to the United States.

The Special Flights Section is often called upon to carry out extensive tours of Overseas Commands for high-ranking Service officials. Viscount Alanbrooke, when CIGS, made a world tour of 33,000 miles in a York aircraft in December, 1945, during which he visited the Middle East, India, Japan, Australia and New Zealand. A similar tour was undertaken by Air Vice-Marshal Fiddament, the Senior Air Staff Officer of Transport Command. He flew 34,000 miles in a Lancastrian and covered the Middle East, India, Malaya, China, Japan and Australia, and returned to the UK *via* Fiji, Hawaii, San Diego, Chicago and Montreal. Sir Ronald Adam, the Adjutant-General to the Forces, and Air Chief Marshal Sir Arthur Barratt, the Inspector-General, have both been flown on extensive tours of the Far Eastern theatres this year.

The operation of air ambulances forms another branch of the work covered by special flights. Between twenty and thirty stretcher cases, and the same number of sitting patients have been lifted each month since the war in Europe ended. Anson, Dominie and Oxford aircraft, with Dakotas for the longer flights, carry out these errands. The provision of nursing orderlies, the selection of suitable airfields near to the hospitals for the dispatching and receiving of patients, and warning action of the flights is all part of the organisation behind these air ambulance lifts.

Although in time the special flights commitments can be expected to decrease, the demands for special aircraft are as numerous to-day as they have ever been, and with the present rate of demobilisation it becomes increasingly difficult to replace trained crews. The high standard of training and experience necessary for this work cannot be acquired in a matter of weeks. The organisation behind these flights, however, becomes steadily easier as the web of air routes rapidly embraces the whole of the world.

BABS

(*Concluded from page 9*)

Runways vary in length, and the BABS beacon is some distance from the upwind end of the runway. All BABS beacons are therefore fitted with a delay switch which ensures that, no matter what length the runway is, the aircraft will always be over the downwind end of the runway when the range scale reads 1·52 nautical miles (10,000 feet). The switch can—and must—be altered whenever the BABS truck is moved from a long to a shorter runway, or vice versa.

The aircraft Rebecca set is a reliable piece of equipment, as most people who have used Rebecca/Eureka will know, and it should not give any trouble. There is nothing mysterious about doing a BABS approach providing it is made a crew effort. Pilot and operator must work together and both must know and understand what the other is doing. Accuracy is all-important; accuracy in flying—accuracy in reading the blips.

If the operator and pilot work together smoothly as a crew, BABS is a reliable and safe landing aid and will get you down safely in almost any weather—but a word of warning. Do not neglect practice once you have become familiar with the operation of the Rebecca/BABS equipment. Practise whenever possible and keep on the top-line.

To show you what can be done by experienced pilots and operators, the following are some statistics from Melbourne, the home of the BABS Flight. During the months of December, January and February, of a total of 3,982 BABS approaches, 2,350 were successful fair weather approaches, 1,630 were successful bad weather approaches, and only 2 approaches, both overshoots, were unsuccessful. The bad weather conditions varied between a visibility of 50 yards to a maximum of 1,000 yards, and a cloud base of zero feet to a maximum of 600 feet. Accidents NIL, and all carried out by using the standard circuit. Surely, then, Rebecca/BABS is something worth knowing.

TRANSPORT SUPPORT DEMONSTRATION

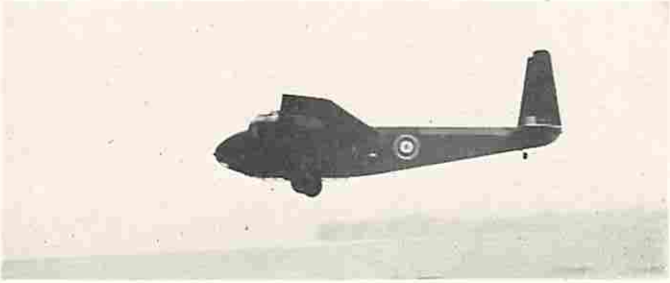
Three Dakotas, flying in vic formation, each drop eight panniers of 350 lb. weight. In the foreground, a RAF Party Contact Car (Air)

On April 2nd the Senior Course of the School of Air Support were given a demonstration at Netheravon of supply and paratroop dropping by units of Nos. 38 and 4 Groups. The paratroops who provided the live jumping demonstration were from the Army Air Corps Holding Battalion. A powered Hamilcar and a Helicopter from Airborne Forces Experimental Establishment also gave flying demonstrations.

With so many different aircraft and flying speeds involved, the timing of the phases had to be meticulously planned and all were well executed. Aircraft were dispatched from Tarrant Rushton to a programme of seconds, and each was allowed a maximum latitude of fifteen seconds between its ETA and ATA over the Dropping Zone.

Ground to air control was exercised by a RAF Party Contact Car (Air). Three of these parties, trained, manned and equipped by No. 38 Group, have just proceeded to the Middle East to serve with the 6th Airborne Division.

RIGHT: *The Sikorski Helicopter, flown by a Fleet Air Arm pilot, provided much interest. After waltzing in front of the spectators, it succeeded in blowing over the Tannoy loudspeaker, then departed vertically*



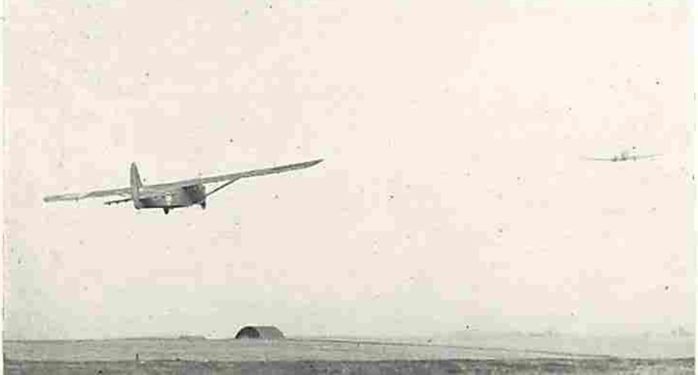
The powered Hamilcar takes off. The Hamilcar is Britain's biggest glider, with a wing-span of 110 ft. and a payload of 17,000 lb. This powered version, the Hamilcar X, will take off under its own power with an all-up weight of 32,000 lb., of which 3,867 lb. is payload. The twin engines are Bristol Mercury XXX. Its original purpose was to extend the range of Halifax-Hamilcar combinations, especially in the Far East

An element of a Parachute Company, dropped by three Dakotas in vic formation from 500 ft. Each aircraft carried fifteen paratroopers. These were all young soldiers having just completed their parachute training. Each man was dropped with full equipment and kit-bag

The Pathfinder stick of paratroops, having been dropped from a Halifax, set up their Eureka beacon in front of the spectators

A Dakota dropping ordnance stores on 18 ft. cotton parachutes. In the foreground (right) is the velometer, an instrument for measuring windspeed on the dropping zone for paratrooping operations

Snatched from the ground, the Hadrian (WACO) glider rises behind the Dakota tug. The glider, flown by a pilot and co-pilot, also carried the Editor and a photographer. "It will be no worse," the pilot told us, "than the wife starting the car in gear." We thought it better than that



Three Halifaxes, at 30-second intervals, each dropped thirteen containers. In this drop one canopy is only just beginning to open as the container reaches the ground

TRANSPORT COMMAND
DEVELOPMENT UNIT

WING COMMANDER T. R. MORRISON

TRANSPORT Command Development Unit is established to serve all formations of the Royal Air Force and Dominion Air Forces in the development of all aspects of air transport operations. The phrase, "air transport operations," is to be taken to include the carriage of passengers, mail and freight of any description by air; reinforcements and ferrying of air movements; airborne operations; supply and maintenance by air; air services and special flight operations; casualty evacuation. So reads the "Aim" in the Directif to the Officer Commanding TCDU, issued by the Air Officer Commanding-in-Chief.

The TCDU is itself a development from the Airborne Forces Tactical Development Unit, established in 1943 in 38 Group to specialise in the new tasks given to the RAF by the Airborne Forces. The limits of the AFTDU's interests were implied in its title. It was exclusively concerned with tactics in support of the airborne forces, and was accordingly sited near the training centres of those forces. When the assault role in Europe was finished the AFTDU broadened its field of inquiries to include transport operations and the name was changed to Air Transport Tactical Development Unit.

In the middle of 1945, No. 38 Group was absorbed into Transport Command and the Development Unit was renamed the Transport Command Development Unit. At the present time the Unit comprises a Transport Flight, a Transport Support Flight and a Trial Installation Section. The Unit shares Brize Norton airfield with the Army Air Transport Development Centre, so the work of these two parallel units is closely integrated. The Army Development Unit is the experimental unit of the airborne forces and is responsible, among other things, for the development of Army equipment for carriage by air and for the breaking down of Army equipment, guns and vehicles to air-portable size. Broadly, it is their responsibility that the load is tactically correct; the TCDU then checks the position of the load, its effect on the structure of the aircraft and the number of lashings which must be used. A joint diagram is then issued for the guidance of both Army and RAF formations, showing precisely how that particular load should be tackled.

Whilst the Development Unit was concentrated on transport support problems, a great deal of research and experiment was carried out in connection with radio and radar aids for locating dropping and landing zones. Methods of blind dropping supplies were tried out with Rebecca/Eureka and with two Gee units. Babs Mark II was thoroughly tested. Rebecca was also fully investigated for use with gliders.

Many of 38 Group's operations at that time were over Norway, and a number of special flights at low altitudes were made by the Development Unit over this territory in order to test the effectiveness of Loran for supply dropping missions.

In close co-operation with Army specialists, various methods of marking and illuminating dropping and landing zones were tried out; this was an almost constant field of experiment, since the enemy was frequently able to learn of the latest developments and to exploit his knowledge in the form of decoys.

One of the first tasks of the Transport Flight of the Development Unit was in preparation for the trooping programme of Transport Command. There were various opinions about how the troops could most comfortably be accommodated in the converted bombers that were to be used. In order to arrive at a reasonable decision, Transport Command ordered the Development Unit to carry out a "Comparative Trial" in two Liberators.

One of the Liberators was fitted out with seats, the other with Numnah matting on which the troops could lie down for the whole journey. The two aircraft flew from Netheravon to India and back, keeping together the whole way, so that each should meet the same weather conditions. A Senior Medical Officer from Transport Command and officers from the Army and Navy accompanied the flight to observe reactions, and the troops were questioned as to their own preferences. The results were in favour of a modified form of seating which was subsequently adopted. At the same time investigations were being carried out to determine the trooping capacities of other aircraft that might be used.

Servicing the aircraft presents quite a problem on such a Unit as this, because of the many different types and modifications in use. The senior NCOs and other ranks of the Trial Installation Section are selected because they are, generally speaking, intelligently curious. Indeed, that should be an ideal qualification for all ranks of TCDU.

Since the Unit serves the Command as a whole, tasks are given to it from the various Groups and branches within the Command, and the aim has been to pick aircrew so that operational experience of each Group is known within the Unit.

An instance of the need for specialised knowledge occurred when the Air Officer Commanding-in-Chief, Transport Command, called for a standard method of aerodrome approach and landing, and the Unit was charged with the task of producing it. The Navigation Section took on this task and the Gee Airfield Approach

System and the Gee/Babs Landing Procedure came into being. Next came the calibration of the airfields in England and in North-West Europe, where the Gee coverage was such that the systems could be used to the best advantage. In October, 1945, alone, forty-two aerodromes were so calibrated.

The Unit carries a number of specialist officers. There are five Technical (Engineer) Officers under the Chief Technical Officer. Besides running the usual daily maintenance and repair and inspections they are responsible for the Trial Installation Section. This Section clears all the loading and lashing diagrams for AATDC and the RAF Civil Engineering Plant Depot at Mill Green. It evolves methods of carrying power plants in aircraft. It converts bomber aircraft to the Transport role, devises power plant stands and trolleys that are air-portable or particularly suitable in some way for the Transport role. It produced, in co-operation with Bomber Command, a method of free-dropping from the bomb bays of aircraft, clothing, medical supplies and food to Allied prisoners of war immediately after the fall of Germany. Navigators are required to show a high standard in all their work, with particular emphasis on radar. Flight Engineers have to be familiar with American, as well as British, aircraft and engines, and the same applies to the Wireless Operators who must get to know both types of radio.

The aircraft held at the Unit vary from day to day, but there is usually a selection of marks of Halifax and Stirling, York and Lancaster, Liberator, Dakota, Mosquito, Helicopter, Hamilcar and Horsa gliders and communication types.

The required standard of aircrew is difficult to maintain in these days of demobilisation, but the aim is to get pilots with experience of about thirty different types of aircraft, at least 1,500 hours total flying and one tour of operations.

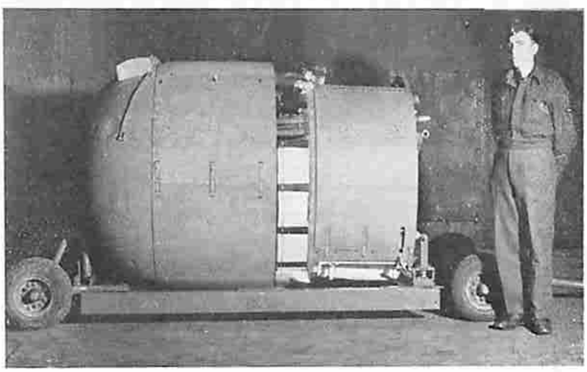
Naturally, in the course of its work, the Development Unit has occasion to seek assistance from, and exchange information with, other establishments interested in research and development, such as the Ministry of Aircraft Production, the Aircraft and Armament Experimental Establishment at Boscombe Down, the Airborne Forces Experimental Establishment, the Telecommunications Research Establishment and aircraft and equipment manufacturers.

Close liaison has always been maintained with the Royal Aircraft Establishment, Farnborough, who attached to the Development Unit in 1944, part of its Aero-Airborne flight engaged at that time in developing for the RAF the American system of glider snatch pick-up. The Americans had already had much success in picking up their 8,000 lb. Hadrians with Dakota tugs, but the RAF wanted to pick up with the same tugs, the much heavier Horsas. This was successfully achieved in experimental operations, and later a Dakota crew from the Development Unit snatched out of France, near Poitiers, a Horsa that had force-landed there and would otherwise have been a write-off.

Another unit with whom the Development Unit has much in common is the School of Air Support at Old Sarum, an Army Unit for whom the TCDU often stages demonstrations.

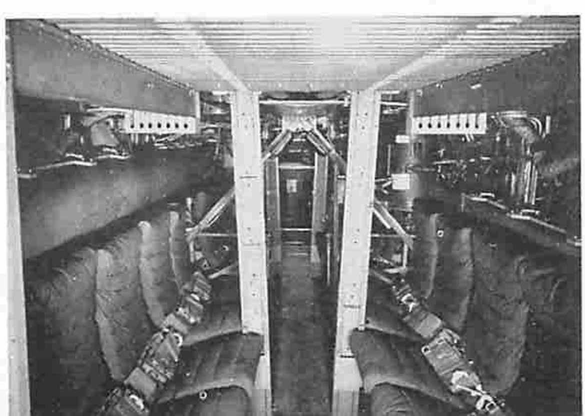
A few of the tasks in hand at the present moment are as follows. A device is being fitted to the engines of the Liberator to prevent overboosting. A container is being devised for the convenient stowage of ship's papers in Transport Command aircraft. Complete handling trials are being carried out in the Halifax C. Mark VIII; three-engined performances of Yorks and Liberators are being ascertained at various heights, after take-off and with various loads. Cradles for the external carriage of power plants (in-line and radial), have been devised and will shortly be test-flown. A passenger, luggage and freight trolley is being devised. An airborne two-wheeled crane is being tested. A tropical version of a Gee box is undergoing trials. VHF Track Guides are undergoing development trials. The London Gee Chain is being test-flown to determine its accuracy and range.

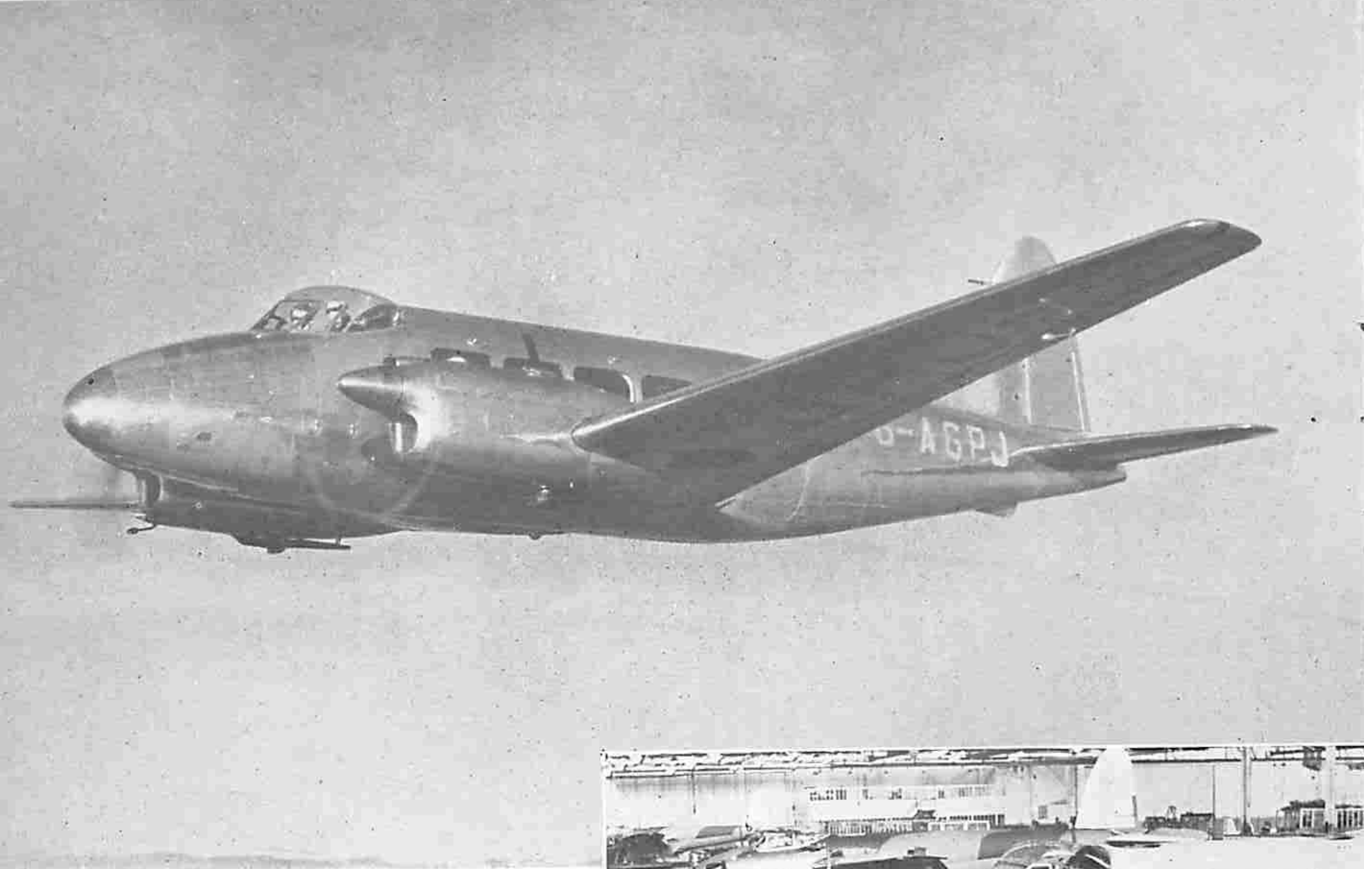
In addition to all these tasks, the Unit is charged with making recommendations for the improvement of present and future aircraft and equipment, of developing tactical and operating technique for Transport Support operations, of studying development and making recommendations on passenger and freight handling, and of collaborating with research and development establishments of all three Services in order to further the development of air transport operations.



ABOVE: *Air-portable power plant trolley designed by TCDU. A Centaurus engine in position*

BELOW: *Seating arrangement for Liberator experimental trooping trip*





THE LAST—AND THE FIRST

Above: the de Havilland Dove in flight. Inset: the last—and 3,229th—Mosquito to be built at the de Havilland works at Hatfield, followed by the first production Dove on the line.

A SHOOTING AFFAIR AT ST. MAWGAN

A York in the arc-lights at St. Mawgan during the shooting of a new Accident Prevention film, featuring Miss Patricia Cutts as "Prudence." It is expected that the film will be available for showing at all RAF Stations by the end of May.

The Gas Turbine for Aircraft Propulsion

G. J. C. DAVIES, B.Sc., A.F.R.Ae.S.

A GREAT deal has been published and spoken about jet propulsion for aircraft, and the popular conception has arisen that any form of gas turbine can be described as a " squirt " or " jet." This is far from being the case since these slang terms should, strictly speaking, only refer to those engines which employ jet propulsion as a means of supplying forward thrust. It is possible to obtain a jet propulsion engine without the use of a gas turbine, and a good example of this is the Italian Campini jet - propelled aircraft, which employs a reciprocating engine to drive the compressor.

It is true, however, that in this country, as well as in Germany, jet propulsion engines for aircraft have been designed to make full use of the inherent advantages of a gas turbine power drive for the compressor, and in this country all credit is due to Air Commodore Frank Whittle for developing the gas turbine driven jet propulsion engine. But the use of the gas turbine as a prime mover is not restricted to pure jet propulsion; there are several other ways of absorbing the power generated according to the plant envisaged. Thus for marine and ground installation, power is usually taken directly from the main shaft, and in the aeronautical field this power can be transmitted to a propeller of conventional design.

Pure jet propulsion is not an economical proposition at speeds much below 500 mph and/or altitudes below 20,000 ft. For this reason, it is not suitable for present-day transport aircraft, but a gas turbine engine driving a conventional propeller does provide great advantages within this range.

The disadvantage of a gas turbine's high fuel consumption is being tackled vigorously in a variety of ways, chief of which is the use of higher compression ratios and/or the use of heat exchangers. With the advent of better turbine blade materials, advantage will also be taken of the possibility of using higher gas temperatures.

With suitable development along these lines, propeller gas turbines will shortly be available which can successfully compete with reciprocating engines of comparable powers.

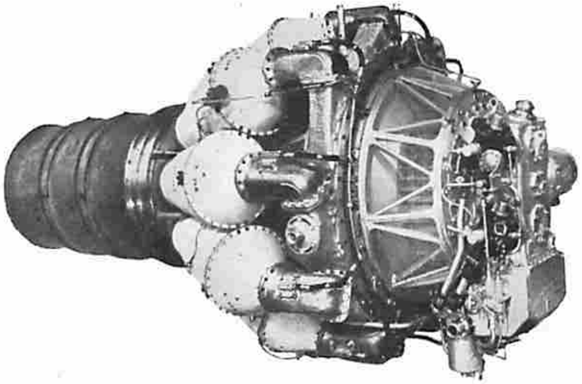
It is in the 4,000/5,000 h.p. class and over that the gas turbine will completely outstrip the reciprocating engine; cooling problems alone become incapable of complete solution in such large sizes of conventional engines.

Much controversy rages between the supporters of the axial type compressor and those of the centrifugal type. Each type has its advantages, and in at least one propeller turbine engine a combination of both is used, mainly in order to achieve the flexibility of the one with the higher efficiency of the other.

The use of a propeller drive does not preclude that of jet thrust and the ratio of thrust obtained by both means can be varied over a wide range.

As operational speeds and heights of transport aircraft increase, in conjunction with the use of pressurised cabins, so the proportion of thrust obtained by jet propulsion will become greater, until even the use of high speed ducted fans will be uneconomical, and pure jets will reign supreme.

Although the gas turbine as a prime mover has come to stay, and the days of the reciprocating aero-engine are numbered, there will, nevertheless, be a great use for propeller type engines for some time to come.



WORLD'S MOST POWERFUL AERO-ENGINE

THE Rolls-Royce "Nene" jet propulsion engine has a thrust rating of 5,000 lb., equivalent to 15,000 h.p. at 600 m.p.h., and weighs only 1,550 lb. This is the newest of the Rolls-Royce "River" series of jet engines and is the most powerful aero-engine in production in the world. Although designed primarily to provide single-engined fighter aircraft with the speed of the twin-engined Meteor, the "Nene" may well be the first engine to power an air liner with jet propulsion.

TRANSPORT FLYING IN THE S.-W. PACIFIC

SQUADRON LEADER BRIAN G. FROW, D.S.O., D.F.C.

WE were a collection of bomber crews with nothing to do when we heard we were to be transferred to transport flying. Our conversion began without enthusiasm, but the pace of it left no time to be bored. In less than a month we embarked on the *Queen Elizabeth* for New York, and by that time we were converted to Dakotas and to the idea of transport work. We were to pick up our Dakotas straight from the production line in Montreal and fly them across the Pacific to bases in Australia. But we were still rather green. A fortnight's intensive training in Canada gave us confidence and familiarised us with the USATC regulations, which had to be observed while flying their routes.

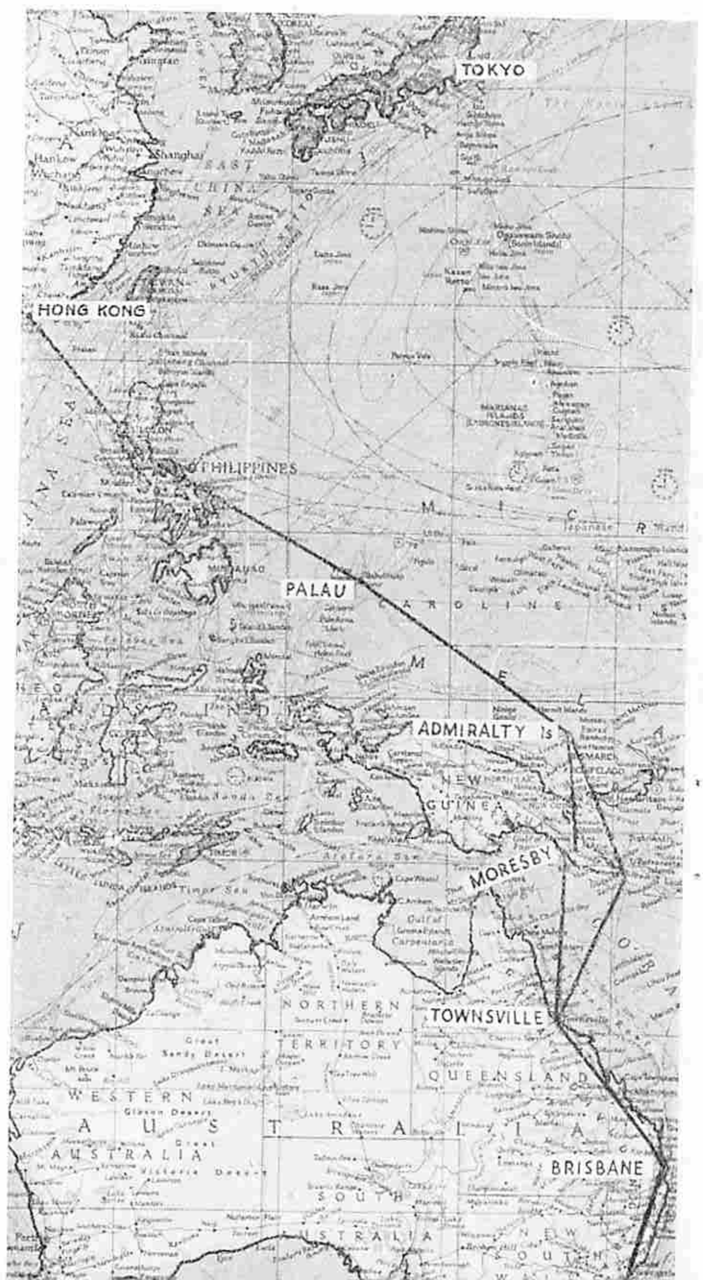
Early in March, we set out on our long journey and, after three weeks' hard flying, arrived in Sydney, by way of Nashville, Tucson, Sacramento, Honolulu, Canton, Fiji, Auckland. The fifteen hours' flight from Sacramento to Honolulu was a severe test for our navigators, who were accustomed to sitting under a screen with a Gee box and a Ground Position Indicator. Just as our transport training had taught us, our main aid had to be astro, with an occasional radio bearing.

We landed on the small strip at Camden, about ten miles from Sydney, which was to be the main flying base for the Group, but our squadron moved to the civil airport of Archerfield, near Brisbane.

The camp was so wild and desolate that everyone had to set to with hammer and nails to provide themselves with even the simplest of accommodation. Maintenance was housed in an old field hospital, but there was no technical material and if we had had to change an engine, only magic could have done it for us. Fortunately, unserviceability was very slight, as our aircraft were new.

After a few weeks we were able to start flying. Our schedule was through Townsville, Milne Bay (the scene in New Guinea of the Australians' heroic rear-guard action in 1942), on to the Admiralties, up to the Palau Islands, which had been captured two or three months previously, and from there to the Philippines, where General MacArthur was fighting his closing battles.

Milne Bay, which provided a midday landing, has a reputation for some of the worst weather for flying in the world, as the cloud base is seldom more than 1,000 feet above sea-level, and usually nearer the 300 feet mark. The strip is bounded on three sides by mountains, six or seven thousand feet high, and on the fourth side is the Bay, in the mouth of which are islands with two thousand foot peaks. The weather in the whole area is normally very unpredictable, with tremendous build-ups, caused by the New Guinea ranges. Radio aids are practically ineffectual, owing to static and the high ground. The only way to approach with any degree of safety was to fly below the overcast, no matter at what height, and map-read your way along the treacherous coast. After we had lost one aircraft it was agreed to change the route. We decided to use the Kokoda Trail, taking off from Townsville in time to go through the trail in the early dawn, before the convection developed, and land at Dobadura on the north coast. The trail is actually a long valley, only a mile wide, stretching straight across



the foot of New Guinea, and is bounded on both sides by mountains up to 9,000 and 13,000 feet. Coming southbound we reversed the process, and flew through the trail to land at Moresby. Using this route as an alternative to flying straight into Milne Bay, depending on the weather conditions, we achieved a far greater degree of safety, but it was still a most dangerous flight.

Our purpose in the South-West Pacific Area was to support the British Fleet. Going north, we carried food, urgent supplies and high-priority passengers, but coming south, our main load was casualties. When the Navy was unable to fill the load, we took any passengers or freight that needed to be carried. It might seem that this work was a comparatively simple task, but one major problem had to be faced—staging posts were simply non-existent in the South-West Pacific Area at that time, and so we had to despatch liaison officers to act for our interests all the way along the route, and small detachments of our technical airmen in order to carry out the daily inspections on our aircraft. Most of the airstrips we were using were controlled by the Americans, who were extremely helpful, but if a major repair was required a special aircraft, with the necessary spares and men, had to be sent from the mainland of Australia, resulting sometimes in many days' delay.

All things combined, life was hard but bearable. After V-J Day we supplied some very interesting special flights, including the first British aircraft into Tokio and Batavia, the latter conveying the Intelligence and Signals personnel, who controlled the British landings two days afterward. Staging Posts by then were in full operation, and we ran regular schedules to Hong Kong and Singapore, as the Fleet moved forward to its advanced bases. We also brought down many British prisoners of war to be repatriated, and occasional Japanese for interrogation.

After a year's work we have now completed our task. When we set out from Somerset the war was still "very much on." The Germans were in retreat, but General MacArthur was fighting a touch-and-go battle at Leyte Gulf, and atomic bombs were still Wellsian theories. The work we came to do had hardly got under way before the peace brought it to a sudden close. But we had learned a great deal about operating Dakotas through tropical areas, and the experience gained under trying conditions was of value to ourselves and to the Command.

THE MILES AEROVAN

WITH a maximum payload of 1 ton, a range of 450 miles at a cruising speed of 110 m.p.h., the Miles Aerovan carries 10 passengers in comfort. With Cirrus Major engines and fixed pitch propellers, maximum speed is 130 m.p.h., and stalling speed at full load is 43 m.p.h. In a 5 m.p.h. wind the aircraft needs only a run of 250 yards to become airborne. It can be operated either as a freighter or as a passenger plane, the change-over being effected in the matter of a few minutes. A fixed tricycle undercarriage with a steerable nosewheel provides a level floor for loading and unloading. In the freighter version the large hinged after-section of the fuselage opens to present the entire unobstructed length of the freight hold for loading and unloading, and it is possible to drive a lorry right up to the rear of the cargo hold.

Full blind flying instruments are provided and a secondary panel carries the push-button switches for the electrically operated trim tabs. The cockpit is so arranged that a crew of one is adequate.

The cabin, with a volume of 530 cubic feet, has straight sides which allow for available space to be usefully employed for the stowage of cargo. The floor, 2 feet above ground level and with a width varying from 5 feet 7 inches to 5 feet, has picketing points at frequent points over its surface and these, used in conjunction with straps and slings, provide a flexible method for firmly securing varied cargo loads. The width of the cabin makes it possible to distribute the load in a more spanwise direction than is normally possible in a small aeroplane, considerably simplifying loading from the point of view of the movement of the centre of gravity.

PAMPA

The Story of Meteorological Reconnaissance over Europe

C. J. M. AANENSEN

FORECASTING weather for aircraft flights over Europe in the days before the war was difficult enough, as any pre-war forecaster at Croydon would tell you, but when France fell and the European mainland became overrun by the Nazis, the lack of weather reports from the Continent was a serious handicap. With little information over the Atlantic, and only the observations of the United Kingdom and the Spanish Peninsula available over the land, weather forecasting became an enigma even in the usual westerly type. On those occasions when the easterly movement of the weather ceased or was replaced by movement in the opposite direction, when winter snows swept across Europe from Siberia or summer thunderstorms moved swiftly northwards across France and Western Germany, forecasting of weather for RAF operations became highly perplexing.

In the summer of 1941, when the gravity of our military position was fully realised by all, but when our resolution to hit back was undaunted, the suggestion arose—"Why not fly over the Continent and get weather observations from under the very noses (or rather over the heads) of the enemy, before sending our bombers on their nightly missions?" This suggestion was taken up and in the late summer of that year two Spitfires were allotted to No. 1401 Flight (then at Mildenhall, and later transferred to Bircham Newton) for the express purpose of obtaining the meteorological information which was so vitally necessary.

It was anticipated that one flight of a round 1,000 miles would be necessary daily; the aircraft were stripped of armament so as to attain the highest possible range and speed. The single occupant of the Spitfire was pilot, navigator, W/T operator and meteorological observer all in one, and his instructions were to go and find out what the weather was anywhere within the range of his aircraft, under any weather conditions and at a moment's notice. The broad terms of this instruction have remained almost unaltered since that date.

At first the sorties were planned by the Central Forecasting Office in the light of general meteorological requirements, but with the growth of Bomber Command's efforts over Europe, the bias of the requirements changed and the sorties were arranged by the Chief Meteorological Officer of Bomber Command in consultation with the Central Forecasting Office. Instead of getting general weather information, the aircraft brought back just that information required to enable the meteorologists to advise how, from the weather point of view, the particular bombing operation which was being planned should be carried out, and whether the chances of success were high enough to warrant the effort.

With the growth of Bomber Command and the increasing depth of penetration into enemy territory, Mosquito aircraft replaced the Spitfires. A crew of two could now be carried, and by sharing the duties, more details of the weather could be recorded. By September, 1942, the number of PAMPA flights required daily had increased so much that the establishment of the flight was raised to eight aircraft—all Mosquitoes, for this type of aircraft had proved itself most suitable for the job. Range, speed and high ceiling were all essential. The general level of flight was 30,000 to 40,000 feet, but at selected places the aircraft would dive down through the clouds so that the observer might note the height of cloud bases, and where the clear layers and breaks in the low cloud occurred. Such descents over enemy territory in broad daylight were hazards of the highest order and the PAMPA crews were fully aware of the dangers. Audacity and skill were called for during these intrusions against weather and the enemy, and flights were not always brought to a successful conclusion.

In the Spring of 1943, the PAMPA Flight was transferred to Bomber Command, by whom most of the sorties had been requested, and at a later date the flight, now No. 1409 Flight, was actively associated with No. 8 Group. But not all requests came from the RAF; our American allies soon realised the vital necessity for additional meteorological information and frequently asked for sorties to be arranged before they went on their bombing missions. In this way the PAMPA Flight continued to provide information for allied bombing operations until the end of the European war.

By then the growth of Transport Command's activities had produced another requirement for PAMPA flights. The incomplete organisation of a network of ground observing stations on the Continent and the lack of regular upper air and cloud data deprived meteorologists of information necessary for the planning of the long-range services of Transport Command. Consequently, a new demand for PAMPA sorties arose, and after the close of the European war, No. 1409 Flight was transferred to Transport Command. The broad aim of the sorties remains the same; when forecasters are doubtful about the weather on part of the route (perhaps there is a front whose intensity is not known, or perhaps it is necessary to know the possibility of getting above a layer of clouds giving ice-accretion, and observations from ground stations are insufficient or indecisive) there is only one way of getting the requisite information, and that is to make a PAMPA sortie. Accordingly, a conference with the duty forecaster is held to decide the route and the height at which the aircraft should fly, the PAMPA crew (who are always at the ready) are summoned to the telephone and the instructions are given—where to go, what weather to expect, and what aspects of the meteorological situation to look for and report on. The navigator checks up, the engines are run up and the aircraft is off. During the war, the PAMPA aircraft mostly kept wireless silence, but to-day the reports come in by W/T whilst the aircraft carries out its sortie.

An outstanding advantage of a PAMPA flight is its flexibility; sorties can be made without delay into any area within range from which detailed information on weather, clouds, icing, etc., is required to amplify routine weather reports from ground stations. A special type of PAMPA sortie, known as "Cloud Survey," is frequently made. The aim in this sortie is not to find out if it is possible for a specific aircraft to fly on a particular route to a stated destination, but to ascertain the cloud structure of a definite type of weather. By such sorties a direct attack on the mysteries of weather is being made to-day by the combined efforts of meteorologists and PAMPA aircrews.

EDITOR'S NOTE: *No. 1409 (Meteorological) Flight in Transport Command was disbanded during April. PAMPA flights, however, continue to be carried out to the requirements of the Meteorological Office by a nucleus of PAMPA crews retained in Bomber Command.*

AIR TRANSPORT INTELLIGENCE

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New Tyre

The Dunlop Company has developed and is now completing final tests on a new type of aircraft tyre. Designated the Compacta, it is a "squat" tyre which has the merit of greatly reduced diameter by comparison with normal pattern tyres of equivalent capacity and pressure.

A typical tyre of normal form at 90 lb. pressure has a diameter/width ratio above 3.25. The diameter/width ratio of the new type is less than 2.

A 90 lb. pressure is being used for the initial trials, and it is stated that tyre life has been found to compare favourably with that of a normal tyre at the same pressure. Full deflection of the ordinary tyre occurs at about three times the static load, but for the "squat" tyre the figure is about 2.5. Total energy absorption is less than normal due to this reduced deflection, and it is stated that some extra leg travel will be necessary to compensate for this loss.

The reduced rolling radius is claimed to increase brake power for a given torque and to reduce side loads on the moving assembly; the disadvantage, however, is that the projected area is slightly greater than for single or twin normal tyres at the same pressure.

Some of the main advantages of the "squat" tyre would benefit the aircraft designer by permitting easier stowage in new aircraft with thin wings and more closely spaced spars, and in some cases will preclude the bulging nacelle.

The company is also developing new types of flexible fuel hose in an endeavour to overcome the fault of the normal hose which fails rapidly when exposed to a petrol fire.

Two new types have been developed which, it is claimed, will stand an engine fire without failure long enough to permit extinguishing measures to be taken. The first is a wire-reinforced high-pressure type comprising a synthetic lining tube over which successive layers of cotton, high-tensile wire and cotton are braided, and finished with an outer cover of synthetic rubber to resist flame action. Braiding of asbestos can also be incorporated to improve flame resistance. This hose is thought to be better than the second and heavier variety, which incorporates materials such as glass fibre, asbestos and heat-resistant cotton, because it is possible to maintain a smaller outside diameter for a given bore size.

* * *

Radio Distance Indicators

The US State Department has announced the signing of an agreement between that country and Great Britain on radio distance indicators on aircraft.

"The necessity for such joint action was brought about by the accelerated research programme pursued during the war and the need for providing frequencies for distance indicators developed by Canada, Britain and more recently Australia," the announcement said.

King Position Computer

An instrument designed to compute and plot radio compass bearings to determine the geographical position of an aircıaft when in flight has been developed by the Carrow Navigation Service, of Houston, Texas.

The device is claimed to make all calculations incident to radio compass navigation. It is stated that multiple station fixes can be computed instantly, so that the "fix" will have maximum accuracy when plotted.

* * *

Millar Celestial Compass

A celestial compass designed and developed to eliminate all computations during observations (with the exception of a simple addition necessary when taking star sights) this instrument is mounted in the astrodome to provide the best possible visibility. The true heading indicator is adjustable to enable the instrument to be easily aligned with the longitudinal axis of the aricraft. The sighting unit is a small telescope with crosslines treated with radium for night use, and a Polaroid screen is fitted for making solar observations.

The time usually taken by computation is saved, it is claimed, by the use of a combination of easily-read scales.

The instrument can also be used for checking or swinging compasses on the ground.

It is manufactured by the Millar Instrument Company, of Newark, N.J.

RAF CORONADOS

The Editor regrets that an abbreviation of the author's article on Coronados in the April REVIEW *resulted in a mis-statement. The Coronados used by the RAF were not refitted with the model 92 engines, but most American operators did effect this change.*

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The circulation of the REVIEW *is limited. Please let others see this copy.*

GOOSE BAY

Transatlantic flight delivery of aircraft was decided upon in March, 1941. The flying stages had to be short enough for medium and light bombers, so the first step was to establish a chain of airfields on the Labrador-Greenland-Iceland route.

Surveys were begun at once, and in July an official of the Canadian Dominion Geodetic Survey Branch reported the location of a potential site in the wild and lonely north corner of Labrador. It was a large, sandy plateau, nearly a hundred feet above the interminable swampy forests, and close by the waters of Goose Bay.

In September an advance party of sixty men in a St. Lawrence ice-breaker nosed their way up the inlet. Two more ships arrived, tents were erected, jetties built and heavy machinery went ashore. Acres of timber were felled, huts replaced the tents, and within a month three temporary runways each 6,000 feet long, were completed. Before the winter closed in, Goose Bay was an airfield ready for service and, with the turn of the year, Liberators were regularly landing and taking off from a surface of 5 inches of compacted snow.

Traffic grew beyond imagination. Finally, the airport covered an area of 32 square miles. Goose Bay, with no overland communication with any other part of the world, became one of the busiest airfields on either side of the Atlantic. Food, equipment, workmen, everything had to be flown in, or make the long sea passage during the summer months when the Bay was free of ice.

Aircraft on delivery, both by USATC and by 45 Group, Transport Command, poured through Goose Bay, winter and summer. There were Mitchells, Marauders, Liberators, Lancasters, Fortresses, Mosquitoes and, of course, the ubiquitous Dakotas. There was also a scheduled service of 45 Group, popularly known as "the milk-run," which carried freight and mail and passengers between Montreal and Goose; fresh vegetables and fruit received far more consideration than passengers, and you had to be pretty important to displace any mail.

Another important function of Goose Bay, of course, was to provide an ever-necessary diversion for west-bound crossings; it has one of the finest weather records of the transatlantic airports. Close by, the crystal-clear waters of the Bay provided an excellent, though little used, summer anchorage for flying boats.

Goose Bay was administered by the RCAF, who incidentally had the fine record of having carried a great part of the burden of men and materials into Labrador without losing an ounce of freight or scratching a wing-tip. The accommodation and entertainment on this lonely forest-ringed camp were surprisingly comfortable.

Although the original objects of Goose Bay have been successfully achieved, it is unlikely that so fine an airport can fail to be of use to peace-time aviation.

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ABOVE: *Normal winter snow depth is 12 ft. at Goose Bay. Water-pipes are therefore carried high round the camp (see* TOP RIGHT).

RIGHT: *Passengers on the "Milk-run" travelled hard.*

BELOW: *Goose Bay airfield photographed from a Beechcraft by Leonard Cottrell, of the B.B.C.*

A CLOSE FIELD — SCENE IN BURMA