



## high speed craft for air co-operation

Fast tenders for service, repair and rescue work  
Medium Speed general utility launches

## EMPIRE AIR TRAINING

between the civilian and the Service mind, this co-operative plan is working supremely well, and any criticism there may originally have been has been silenced by the practical results obtained. To quote one example, in one year at one Elementary Flying School no fewer than 1,800,000 miles, or 24,000 hours, were flown; there is no arguing with a fact like this, especially if one contrasts it with the 1,200 hours flown by the whole of the R.C.A.F. in 1932!

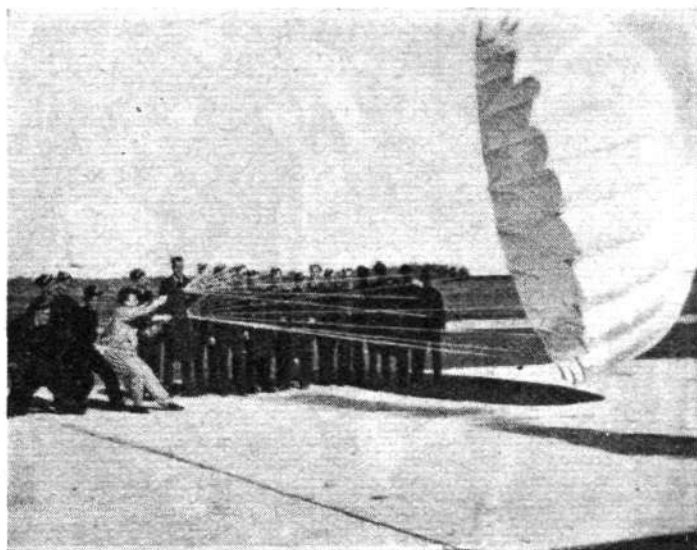
Until the entry of the United States into the war, a considerable number of Americans crossed the border and volunteered for training in Canada as if they were Canadian entrants. They not infrequently wear the letters U.S.A. beneath the word Canada on the shoulders of their jackets.

The Dominion is an ideal country for such an undertaking as the Training Scheme. It occupies a central position in the British Commonwealth, half-way between the Old Country, Australia and New Zealand, and within a few hours of the vast industrial resources of the United States; but, what is perhaps more important still, Canada is particularly air-minded.

Climatic conditions in the Dominion permit of flying all the year round. Even in the winter, when the ground is heavily snow-bound, flying continues. At first the runways are snow-ploughed, and after, when the snow gets too deep for that, it is rolled down and hard surface snow runways made.

### Constant Stream of Recruits

There are 20 recruiting centres across the Dominion, and, owing to the air-mindedness of young Canadians, a constant stream of recruits of the very finest human material is available. In addition to the Commonwealth Air Training Scheme schools we have been able, through the hospitality of the Canadian Government, to transfer R.A.F. schools to that country. These schools can now operate at full intensity free from the chance of enemy interference, and under very much better weather conditions than could be expected in the United Kingdom. The resultant increase in potential output is very considerable.



**JUST IN CASE :** Although parachute jumps are not included in the practical training of the young airmen, instruction is given in the operation of the 'chute and how and when to use it. Here an instructor is giving a practical demonstration—with the help of a gentle breeze—to a group of R.C.A.F. students

A gratifying aspect of the whole business is the fewness of accidents on first solo flights, and this speaks well for the thoroughness of the flying instruction given at the Elementary Flying Schools. To quote again from Norman Smith's booklet: "Accidents occur, rather, when the pupil begins to feel his oats and starts frightening farmers on country roads or waving to his girl in the college campus." But you cannot have the spirit that makes a good fighter pilot without a little of that sort of dare-devilry showing itself now and then in advance of requirements.

Canada is also providing us with considerable numbers of skilled technicians both for service with the R.A.F. and to act as ground personnel for R.C.A.F. squadrons. By agreement with the respective Governments, Royal Canadian Air Force, Royal Australian Air Force, and Royal New Zealand Air Force squadrons are formed in this country. These are manned by crews trained under the Commonwealth Scheme. Large numbers of crews



**FLYING AT LAST :** After passing through the Manning Depot and graduating from the eight weeks' course at an Initial Training School where their only taste of "flying" has been in an earth-bound Link, student pilots move on to one of the Elementary Flying Training Schools and get their first taste of the genuine article. Here are some student-pilots at No. 3 E.F.T.S. at London, Ontario, with their Fleet Finch trainers in the background.





**FINDING THEIR WAY :** A class of student air-observers are here seen practising navigation over the Manitoban plains in the cabin of a Jacobs-engined Anson.

trained under the Scheme also serve in R.A.F. squadrons.

Training for the various air crew categories is also carried out in Australia, all recruits receiving their preliminary ground-training there. Some of them then go on to Canada, others to Southern Rhodesia, while the remainder complete their flying training in the Commonwealth. The Australian training organisation has exceeded schedule.

The Moth Minor, which was gaining great popularity among private pilots when war broke out, is now being turned out in Australia as an elementary trainer, and this excellent little low-wing monoplane, with its inverted four-cylinder 90 h.p. Gipsy engine, is doing great work down under. For more advanced training the Australian-built Wirraway (basically a Harvard in design) is largely used.

A number of crews, on completion of their training, are posted direct to R.A.A.F. squadrons in Australia; others go to R.A.A.F. and R.A.F. squadrons in the Middle East and elsewhere. A proportion have come to this country for service with the R.A.A.F. or the R.A.F. Ground personnel for service with the R.A.A.F. in this country and the various war fronts are also provided by Australian training.

#### **New Zealand and Africa**

As part of the same Scheme, training is also being carried out in New Zealand, where pupils of each category receive their preliminary ground training. Observer and air gunner pupils, together with a proportion of pilot pupils, are then sent to Canada for further training. The balance of the pilot pupils complete their training in New Zealand.

The training scheme in New Zealand has been complete for some time, but the schools have been progressively expanded. The total pilots produced by the schools, exclusive of air crew personnel sent to Canada for further training, has reached a remarkable figure from such small resources.

By agreement with the South African Government, the training organisation in the Union has been expanded and a number of newly constructed schools are now being fed with pilot and observer pupils from this country.

Now that the scheme is expanding, considerable numbers are joining the R.A.F. squadrons in the Middle East, but hitherto the pilots, observers and air-gunners trained in South Africa have mostly been posted to South African Air Force squadrons operating in East and West Africa. As the expansion continues the numbers of air crews joining R.A.F. squadrons in the Middle East will increase and South African trained pilots will also be sent over to Royal Air Force squadrons here.

In addition to the expansion of the South African training organisation, the South African Government has readily facilitated the transfer of R.A.F. observer training

## **EMPIRE AIR TRAINING**

schools to South Africa, together with a reconnaissance school. The preliminary ground training for the former schools is carried out in this country. Pupils for the reconnaissance school are mostly provided from the advanced flying training schools in Southern Rhodesia, although a small number of them come from South Africa.

Pilot training schools have also been operating to full capacity in Southern Rhodesia for some considerable time, while schools for the training of observers and air gunners have just been opened. Preliminary ground training is also going on in Southern Rhodesia for pupils provided in part from this country, in part from Australia, and in part from personnel domiciled in Southern Rhodesia.

When they are drafted to Britain, men of the Commonwealth Scheme go to a reception centre under Flying Training Command. From there they move forward to the last stage of operational training, and subsequent posting to operational squadrons.

The combined productive effort of trained personnel from these vast Air Force training programmes is nearing its peak. From small beginnings a force of devastating strength has arisen. Canadians and Newfoundlanders; Australians and New Zealanders; South Africans and Rhodesians are all fighting side by side in and with the Royal Air Force, and together with Englishmen, Scotsmen, Welshmen and Irishmen Empire trained.

#### **Britons from Everywhere**

But even these do not exhaust the list, for there has been a steady influx of recruits from India, Straits Settlements, Bermuda and other British possessions rarely heard of in the ordinary way; the British colony in Argentina, for instance, sent two lots of trainees, while from many of the conquered parts of Europe have come airmen trained and untrained.

Men of the Commonwealth Training Scheme have already distinguished themselves on every air front, and many have been awarded honours.

Every Dominion, every Colony, every part, great and small, of the British Empire is adding daily to the supreme air war effort.

The originally estimated cost of the three-year training plan was \$600,000,000, but this was drastically revised towards the middle of last year when it was realised that the joint expenditure to March 31st, 1943, of all countries taking part in it would work out at approximately \$824,000,000, plus another \$28,000,000 to complete the training of pupils already in the advanced schools.

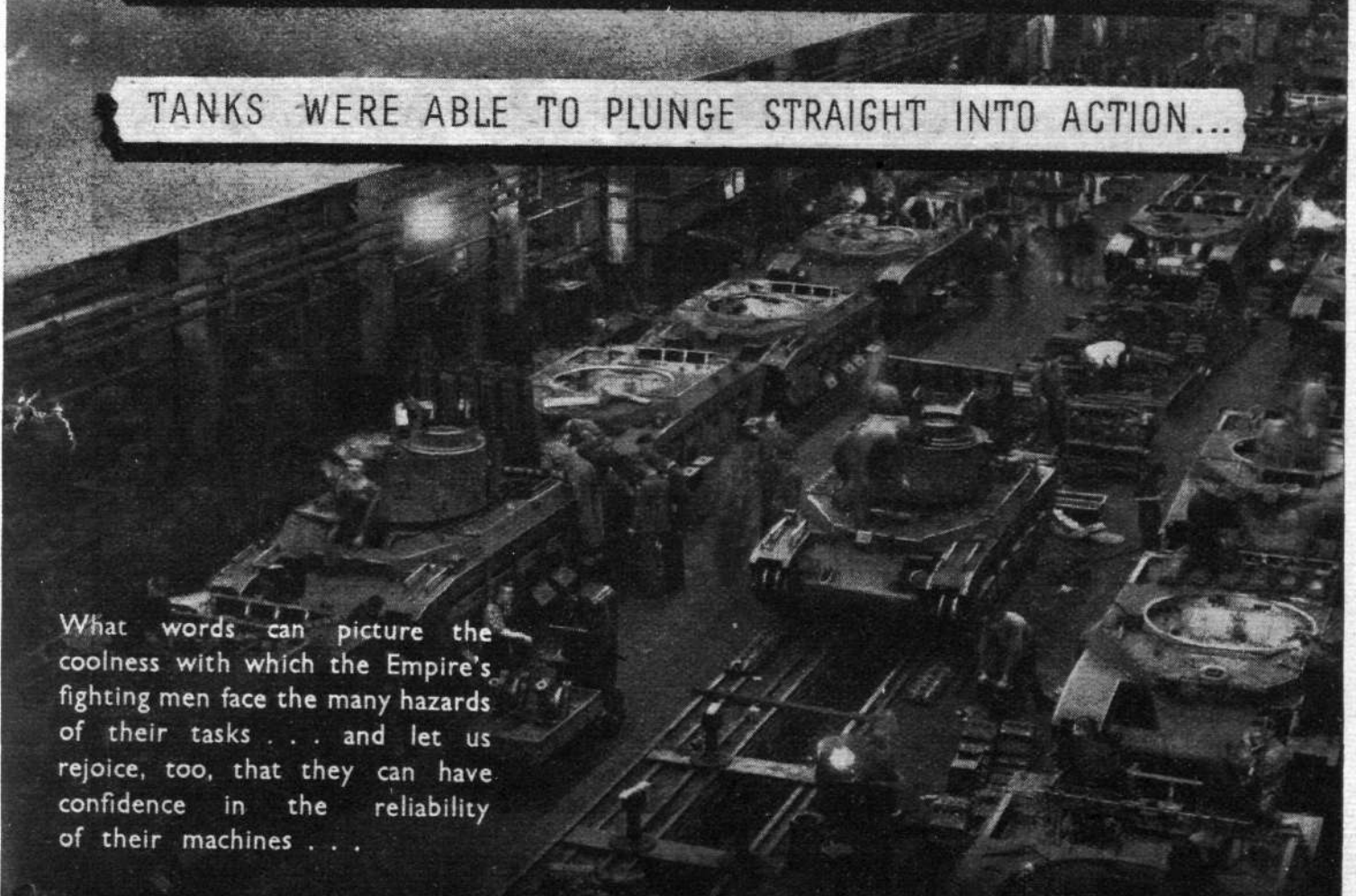


**THE CONTACT MAN :** The student wireless operator-air gunner, whose ultimate job it will be to contact his base by radio and the enemy by machine-gun fire, is here seen practising the former art in a Noorduyn "Norseman" trainer.



...AND AFTER A DESERT JOURNEY OF 600 MILES OUR

TANKS WERE ABLE TO PLUNGE STRAIGHT INTO ACTION...



What words can picture the coolness with which the Empire's fighting men face the many hazards of their tasks . . . and let us rejoice, too, that they can have confidence in the reliability of their machines . . .

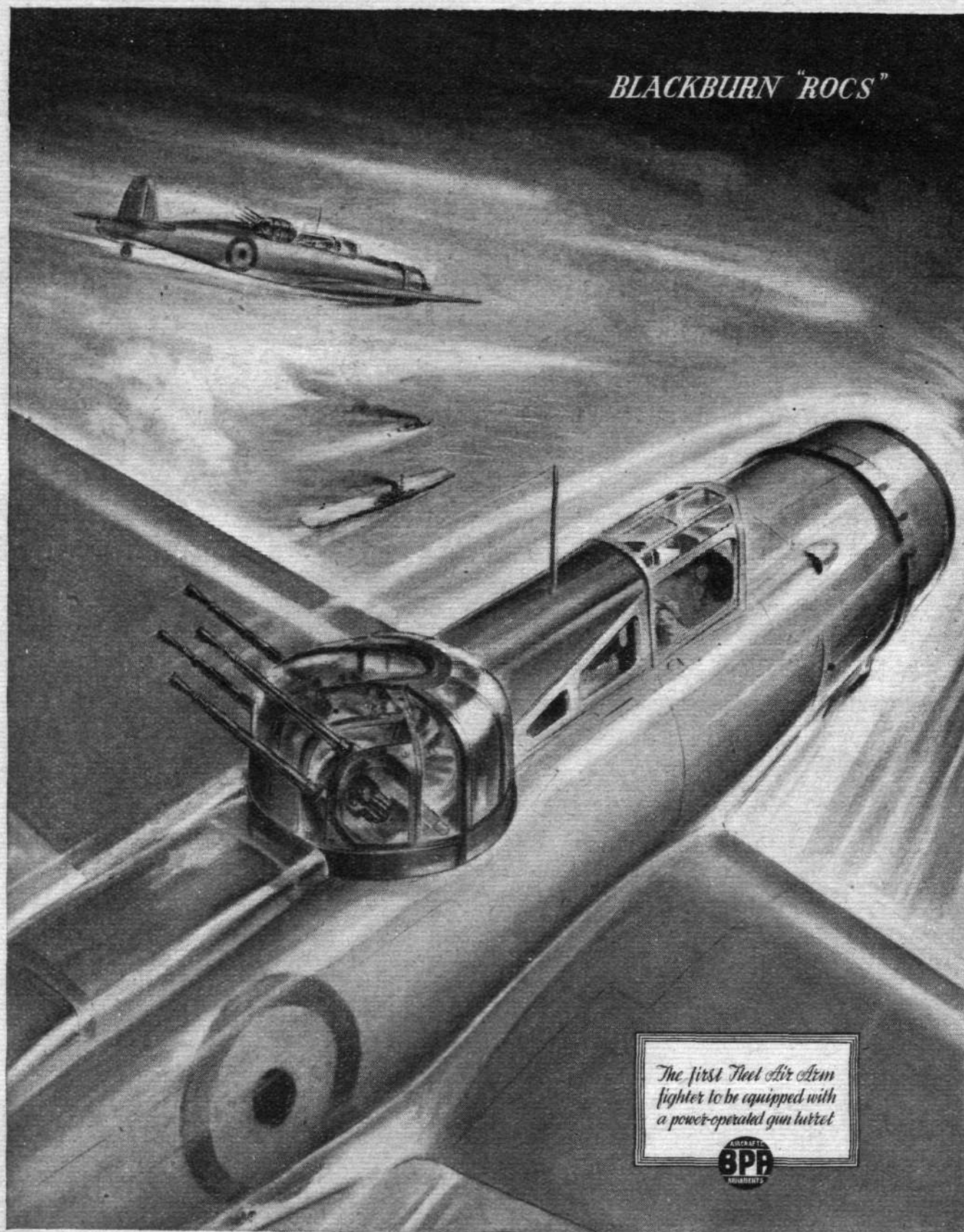
**...THANKS TO BRITISH CRAFTSMANSHIP**

C 5



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# BEHIND THE LINES

Service and Industrial News from the Inside of Axis and Enemy-occupied Countries

## More Gliders

THE Gothaer Waggonfabrik, hitherto engaged on quantity production of aircraft designed by other firms, is now busy on the manufacture of a new troop transport glider. This is a 10-seater type with a span of 72ft. and 48ft. length. Empty weight 1,800 lb.; gross weight 4,500 lb. The "cruising speed" of the glider, towed by a Ju 52, is said to be 100 m.p.h.

## Air France Equipment

TWO Amiot 370s are in service on the important line operated by the Compagnie Jibuti-France. The Amiot 370 is powered with the Hispano 12-Y liquid-cooled engine, and is a direct descendant of a series of Amiot 354 twin-engined bombers. Another Amiot, the 356, employed by the company, is powered with two Rolls-Royce Merlin liquid-cooled 12-cyl. engines, and has a cruising speed of 220 m.p.h. The Amiot 370 is reported to have recently covered the journey from Jibuti to Marseilles-Marignane in 17 hours.

## Regia Aeronautica

THE administrative branch of the Italian Air Force has been reorganised, and the following composition of personnel has been decided upon:—  
*Officers:* 1 Lt.-General; 3 Maj.-Generals; 21 Colonels; 56 Lt.-Colonels; 48 Majors; 230 Captains; 217 Subalterns. In addition, 180 Captains and 315 Subalterns are to be employed for office work.

The N.C.O. strength is to be divided as follows:—In the flying branch: 420 Warrant Officers; 630 Sgt.-Majors; 700 Sergeants; and 1,750 Corporals. In the base units 415 Warrant Officers; 448 Sgt.-Majors; 475 Sergeants, and 2,142 Corporals. The N.C.O. per-



The Amiot 370, powered with a Hispano 12-Y, now on Colonial service.

sonnel of the technical branch is to be composed of 1,157 Warrant Officers; 1,258 Sgt.-Majors; 1,332 Sergeants; and 6,103 Corporals.

## Italy's Fighter

THE growing employment of liquid-cooled, in-line power plants is a characteristic trend of development of new designs of Italian fighter aircraft.

A picture of one of these new types was shown in *Flight* of February 5th. Another representative of this class is the Macchi C.202 single-seater fighter developed by the Aeronautica Macchi, S.A. While no details are available, the type is apparently a development of the Macchi C.200 single-seater fighter.

## Luftwaffe's Health

AN appeal for volunteers for health officers for the *Luftwaffe* is published in the German daily press. It is likely that the spread of typhoid and other diseases on the Russian front, and the overcrowding of German base hospitals in occupied Poland, is re-

sponsible for this urgent call. The appeal is specially directed to pupils of secondary schools who are taking their matriculation for examinations in 1943, and who normally would be called up in August, 1942. After a period of training volunteers will be given commissions with the Medical Branch of the *Luftwaffe*.

## A French Flying Boat

THE Potez-SCAN 161 six-engined flying boat has been completed and is undergoing test trials. Originally designed for transatlantic passenger traffic, the aircraft has been adopted for freight. It has a length of 106ft. zin. and has an interesting arrangement of wing floats retracting in the nacelles of the outboard engines. From the Sartrouville yard the large flying boat is being transported (dismantled) to Caudebec-en-Caux, where it is to be reassembled and tested, under the direction of the designer, M. Haurel. In the first full-out test the machine is to be flown to Les Mureaux, where further tests with larger loads are to be made.

## "Lo Stormo del Sacrificio"

AN Italian torpedo-bomber unit carries the impressive name of the "Sacrifice Group." Originally a bomber unit equipped with three-engined aircraft and operating in N. Africa and over Malta, the group lost 37 per cent. of its strength in the first five months of the war.

The unit seems to be unlucky in encounters with the R.A.F., and only three members of the original crews are still operating. Few Italian airmen seem to be keen on joining this unit.

The Macchi C.202 is one of the latest Italian fighters.







# War in the Air

The target for to-night is "Somewhere in Germany." Handley Page Halifax bombers on their way.

## *The Lull in Libya : Air Activity in Burma : Americans and Australians Raid Pacific Air Bases*

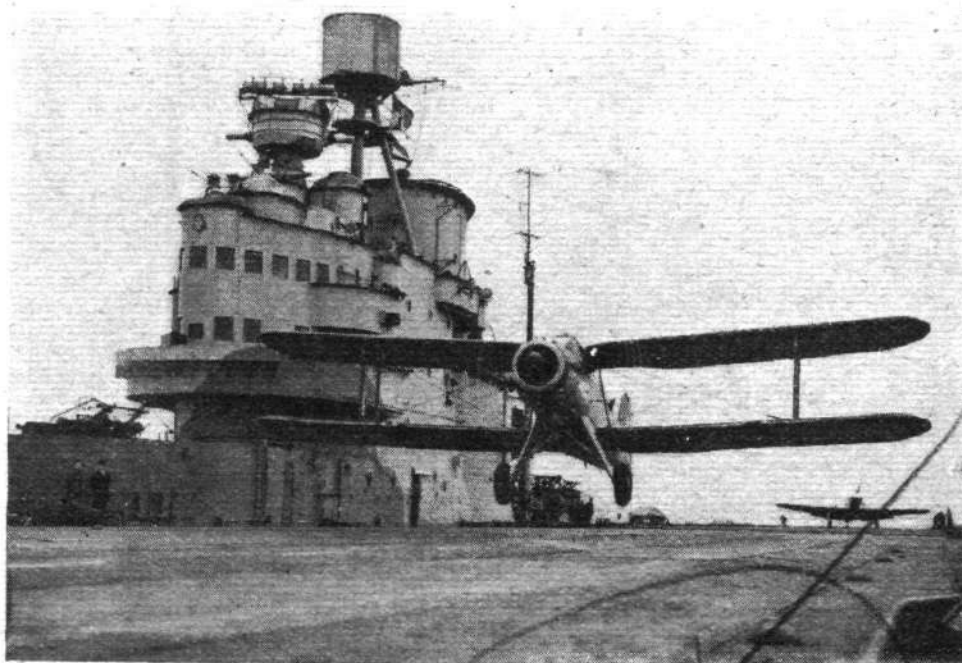
THE strangest thing about the war of late has been the prolonged lull in the battle in Libya. For a while bad weather accounted for the inactivity on both sides, but this has been less consistent of late. There has been patrol activity, in which it seems that our men have had the better of the enemy, but the reluctance of both sides to make a serious attack on the other has provided somewhat of a mystery. It may be that both are waiting for reinforcements, particularly of heavy tanks, and it is much to be hoped that the Japanese have not yet been able to interfere to any extent with the stream of ships which brings material up to General Auchinleck's forces.

Despite the recent bad weather, Empire aircraft have not ceased their activities, devoting most of their attention to the enemy's airfields, of which Martuba is now the chief, as well as raiding his ports. There have also been raids on his air bases in Greece. Martuba is raided with regularity, and Messerschmitts which try to defend it usually provide some victims to the Kittyhawks which accom-

pany our bombers. These Kittyhawks are certainly good, but that is not to say that they are better than our own Spitfires and Hurricanes. Frequent mention is made of them because it is a deliberate policy that the Middle East should be mainly equipped with American machines, while Hurricanes and Spitfires are

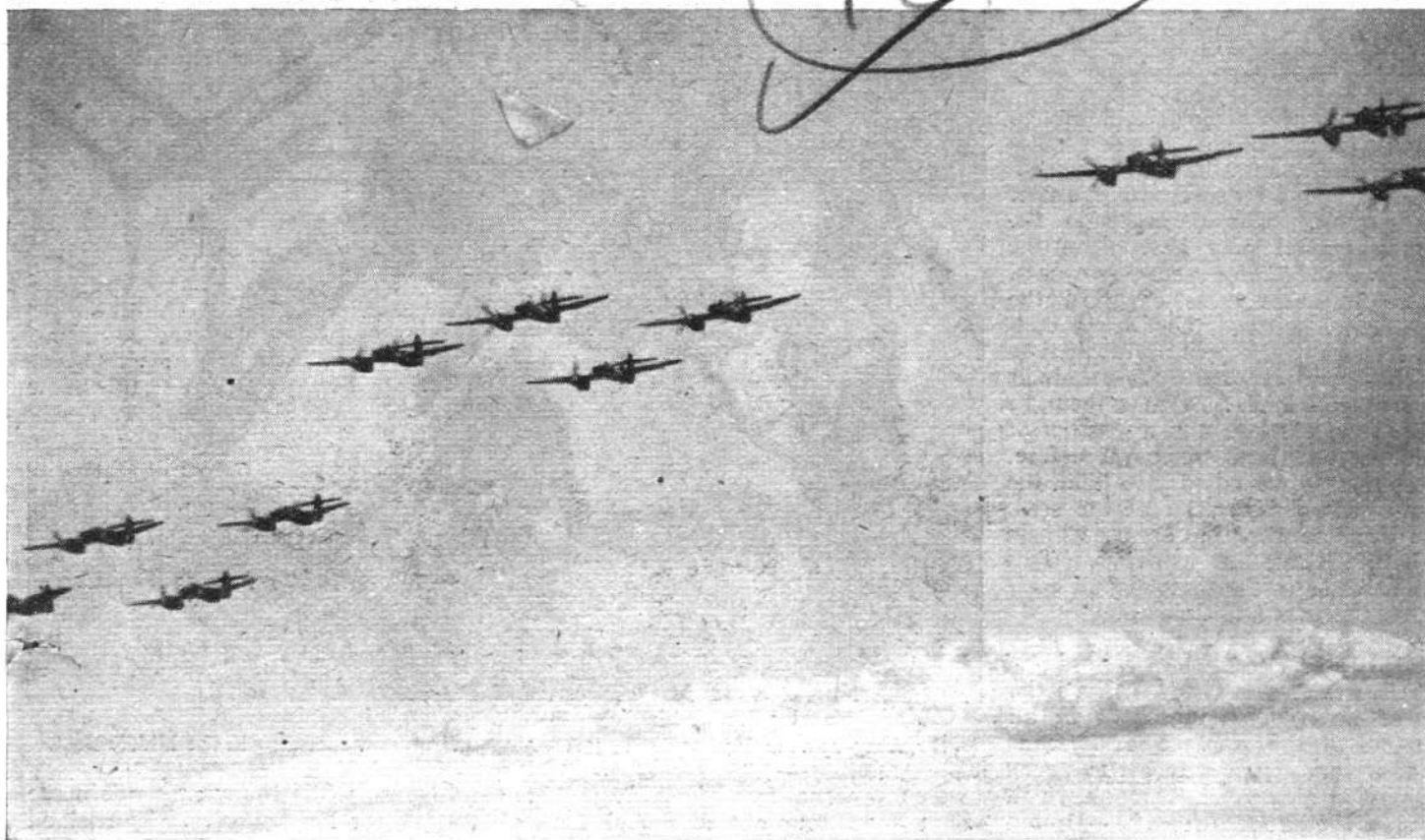
used at home and in Malta. A good many Hurricanes are also being sent to Russia, where they are highly appreciated by the Red pilots.

In Burma fierce fighting continues. At Toungoo, on the road to Mandalay, Chinese troops are barring the way, and recently they were heavily attacked, and had no air support them-



THE NAVY THAT FLIES : A Fairey Albacore taking off from flight deck of H.M.S. Victorious.

Photo news



How many shells a minute? Four-cannon Whirlwinds in formation.

selves. None the less, they recovered ground which had first been lost to the Japanese. The American Volunteer Group has joined the Chinese forces in the Shan States, and one day last week they made determined raids on airfields occupied by the Japanese in Siam. The more important raid was on Chiengmai, the terminus of the railway from Bangkok, where some 50 enemy aircraft were taken by surprise on the ground. Seven to ten of them were completely disabled and several others were probably disabled while others were damaged. The other raid was on Lampun, about 10 miles away from Chiengmai. There is talk of a contingent of regular

American Army squadrons being sent from India to the Burma front.

The Americans, working with the R.A.A.F., are continuing to harass the Japanese in New Guinea. One day last week four American Fortresses and two Australian Hudsons, escorted by nine Curtiss P40 fighters, attacked the airfield at Lae and destroyed 15 enemy machines, besides damaging others, for a loss of two of the Curtiss fighters.

#### New Japanese Bombers

THE Japanese have sent a new type of bomber against Corregidor and Bataan in the island of Luzon. It is said that they did little damage. Three

of them were shot down by A.A. fire, but no details about them have been published. They may have fallen in the sea.

It has recently been disclosed that Chinese air pilots have been undergoing training at Arizona Field in the United States, and that the first batch has just completed its course. R.A.F. officers who have been in the Far East have formed the opinion that, on the whole, the Chinese make better pilots than the Japanese do. However, we have no reason to despise the Japanese air effort up to date in the present war.

The importance of Wake and Guam Islands, which the Japanese seized as soon as they entered the war, is their utility as air bases. But, probably from the over-confidence with which their rapid successes have inspired them, or perhaps because they have conceived an unwarranted contempt for the Americans after surprising them at Pearl Harbour, the Japanese neglected to garrison them strongly. It has just been made known that the enterprising American Admiral Halsey, who raided the Marshall Islands in January, went on to shell Wake Island in February, and Marcus Island (a Japanese possession) on March 4th. Few enemy ships or aircraft were found at either place, and the American cruisers and bombers rained shells and bombs on what they did find, destroying enemy buildings and the



Fifty-six passengers in a Sunderland flying boat! Members of the crew of a torpedoed steamer arrive safely ashore.

Keep stone



## WAR IN THE AIR

runways on the airfields. Although Marcus Island is nearly 1,000 miles away from Japan, a black-out was enforced in Tokyo for several nights after this exploit. The darkness in the Nippon capital may have been the shadow cast before by coming events.

The Japanese have occupied the Andaman Islands in the Bay of Bengal, famous as the penal settlement to which the most obnoxious criminals are sent from India. Some of them, as well as the garrison and a number of civilians, had been taken off before, as obviously we could not hold the islands without mastery of the seas. One wonders what the enemy will do with the remaining convicts. This action increases the threat of air raiding on Calcutta and Colombo.

### Bombing on Both Sides

THIS week's story ends with a series of heavy bombing raids in all quarters of the war. The Germans made a very strong attempt to wreck the port of Murmansk, through which most of the supplies from the United Kingdom and America reach Russia. The Germans sent over wave after wave of Ju. 87s and 88s, with escorts of Messerschmitts and fighter Heinkels. The Russian defenders included Hurricanes. More than 100 machines on each side took part in the fight. No damage was done to the town, for the bombs were dropped at random, and 11 German machines were shot down and two were badly damaged.

The Japanese made yet another heavy raid on Corregidor on March 26th, which lasted for six hours. No mention was made of their new type of bomber. Only slight damage was done to military objectives, and there



Bombing-up a seaplane of the Yugoslav air squadron now operating in the Middle East.

were few casualties. The A.A. gunners shot down four out of the 54 heavy machines which carried out the raid.

Raiding on Port Moresby in New Guinea continues, with the R.A.A.F. hitting back at Rabaul. In one recent raid the enemy dropped 24 bombs in the harbour at Port Moresby, and the inhabitants hurried out to gather up the fish killed by the explosions.

An attack on Malta by Ju. 88s and Stukas on March 26th was so intense that it was compared to those when the *Illustrious* was in the harbour, and it was only one of a series of heavy raids. On the day before Spitfires and Hurricanes met the raiders and fought one of the greatest air battles ever waged over Malta. Our fighters had

no losses, while the enemy was made to pay for his temerity. The island continues to send its bombers out to hit the enemy in all directions.

After several inactive nights, for which ground mists were mainly responsible, Bomber Command struck at Essen and other places in the Ruhr on the night of Wednesday, March 25th. All the important centres in Germany have powerful defences, and our men did not come off unscathed. In that and other operations we lost 11 bombers that night. But photographs now confirm that in recent attacks on the Ruhr and Cologne the wreckage in German factories was very satisfactory. Essen is a profitable target.



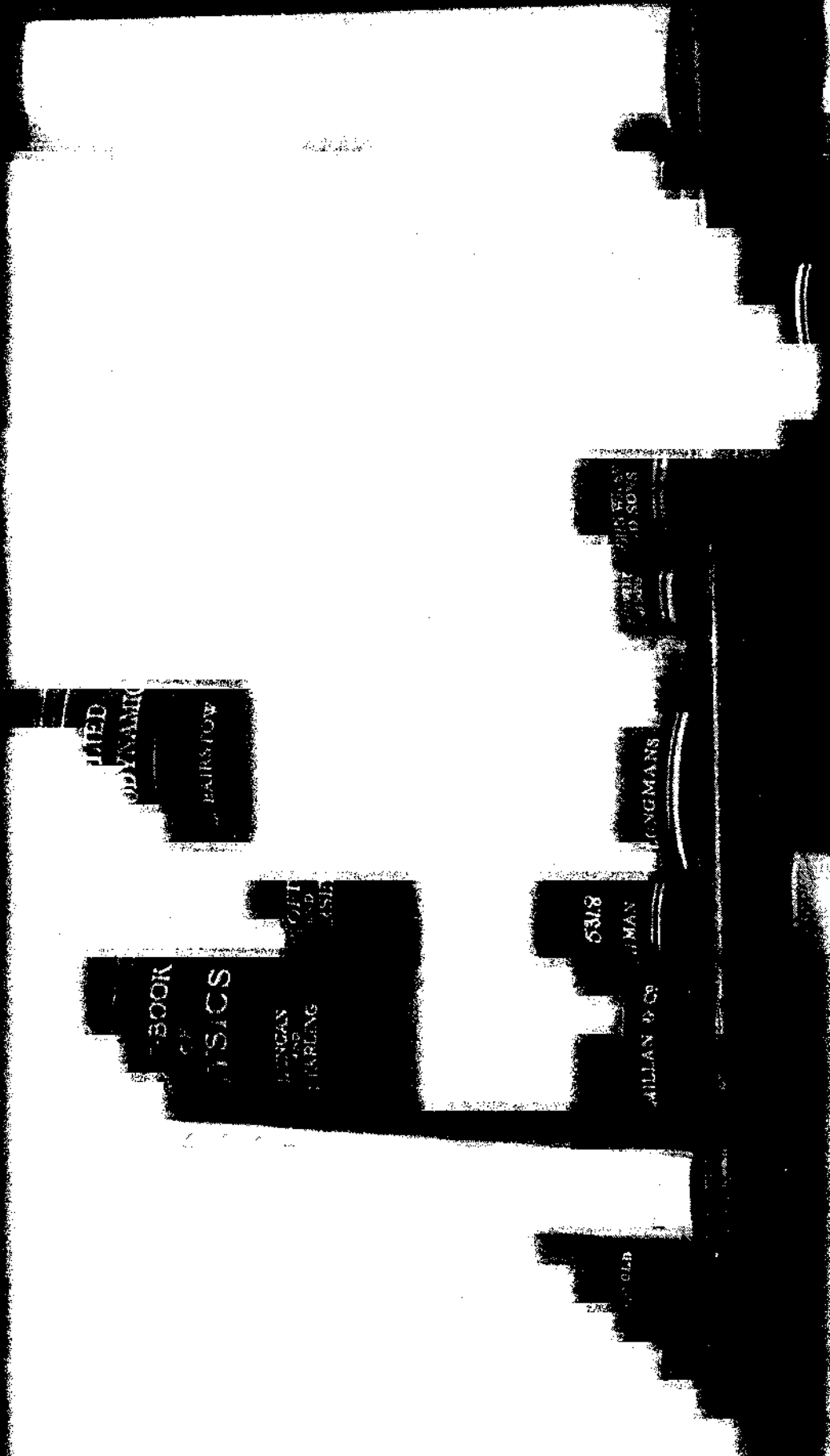
ON THE AUSTRALIAN FRONT: Lockheed Hudsons line up on an airfield in Northern Australia, ready for a long reconnaissance over the "Jap-infested" Timor Sea.

Associated Press

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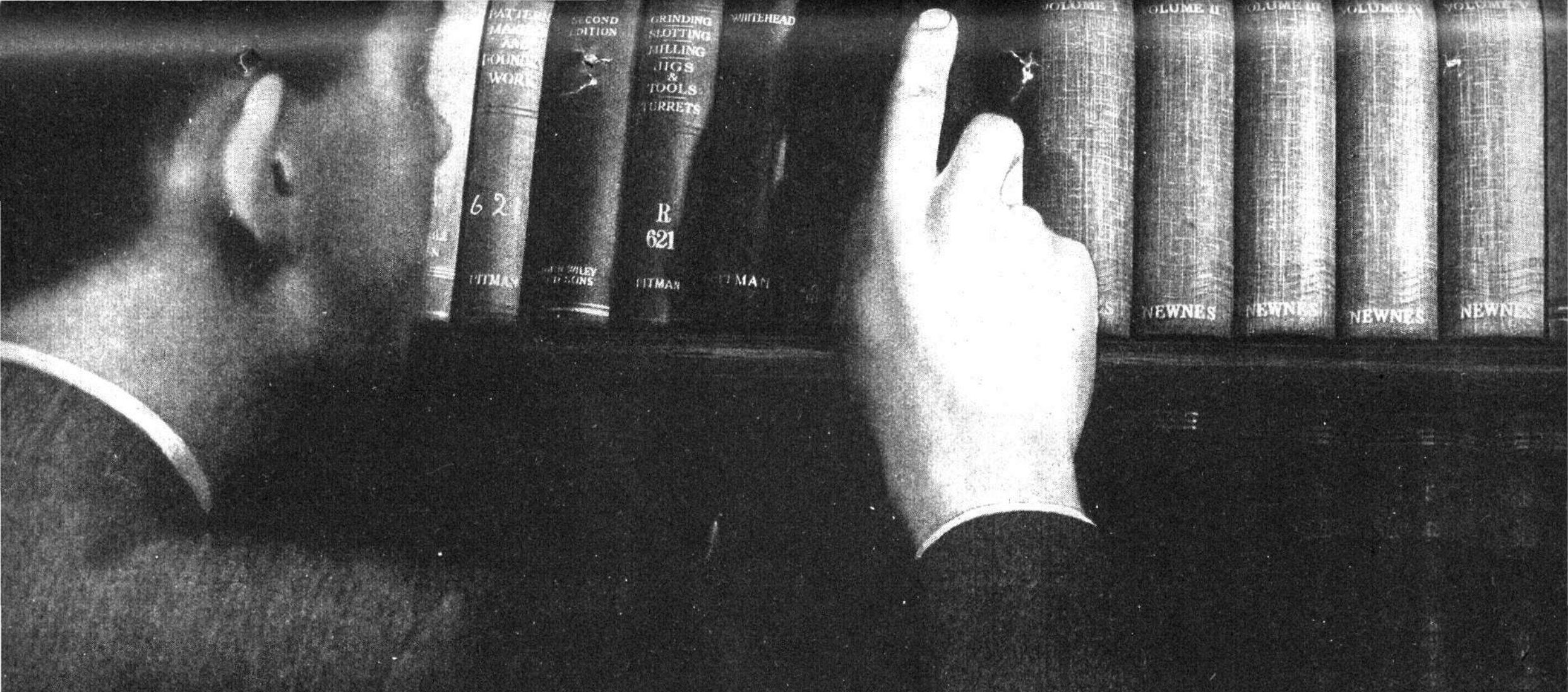
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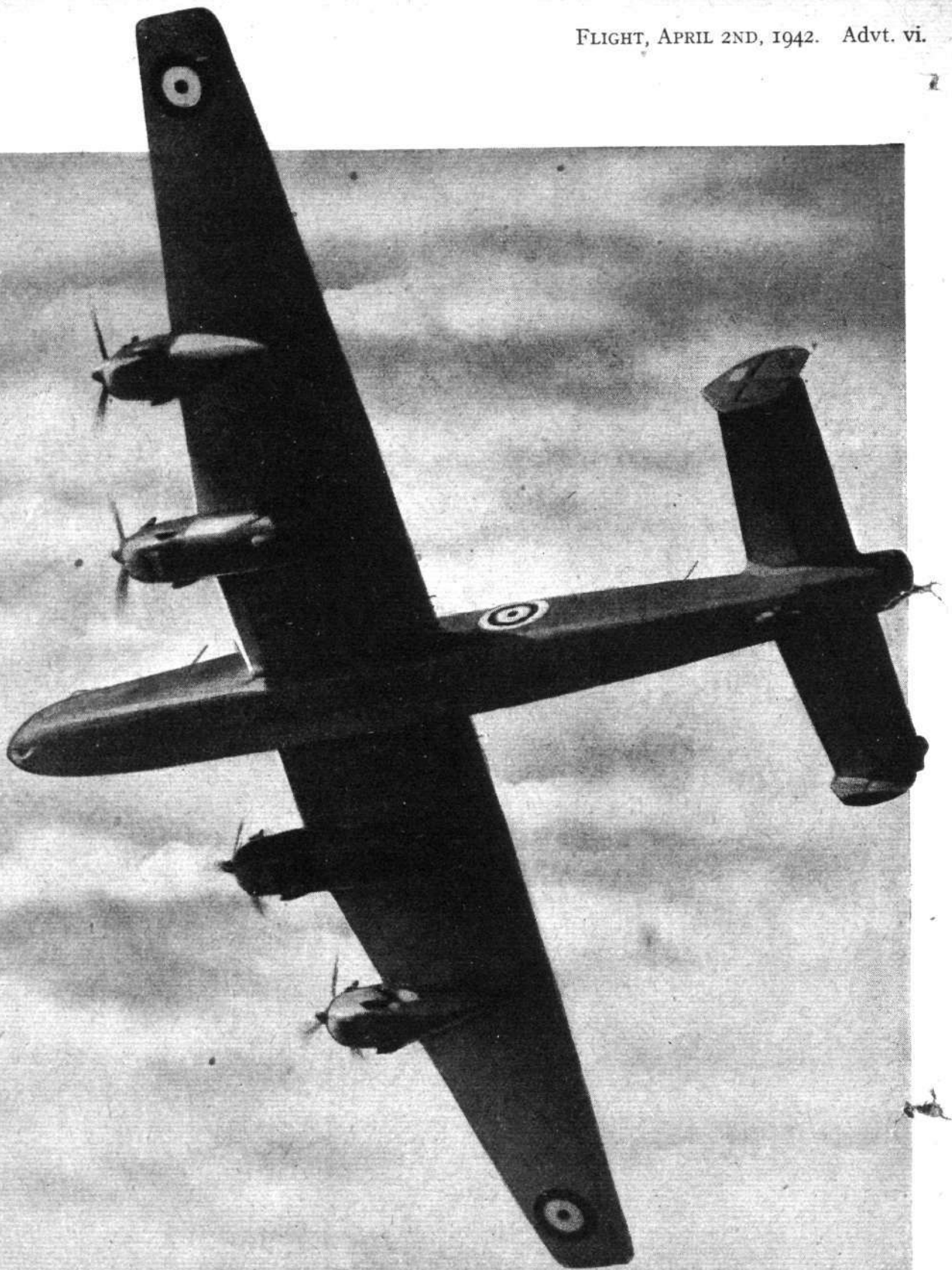
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## EDUCATION

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## The HALIFAX

We have no idea who laid out the general outline, but whoever it was deserves great credit.

HANDLEY PAGE LIMITED

"Flight"

# TOPICAL AIRCRAFT PROBLEMS—II

## Pressure Cabins : Super-sonic Speed Limitations : Airscrew and Control Difficulties at High Speeds : Flutter

By PROF. DR.-ING. GÜNTHER BOCK

(Continued from page 294)

IN the first part we examined the design solutions which on the part of the power plant were needed to enable it to fulfil the requirements at great altitudes. On the part of the airframe, too, special precautions are necessary. In the human organism disturbances arise at altitudes of more than 12,000 metres (40,000ft.), even when breathing pure oxygen. It is therefore necessary to raise the pressure of the air used by the crew for breathing to something above the external pressure and for that reason to place the crew in a pressure cabin.

The arrangements necessary in the pressure cabin for retaining the air pressure for breathing are shown diagrammatically in Fig. 16. The air for breathing can either be tapped off from the engine supercharger or it can be drawn in from the free air. After compression it is reduced to the desired temperature by a cooler and flows then through a filter in which any oil that might be present is drawn off, and finally into the pressure cabin. A constant pressure is maintained in the cabin by pressure-retaining valves controlled by barometer capsules. In order to make quite sure of preventing an excess of pressure an additional high-pressure release valve may be provided. In order to

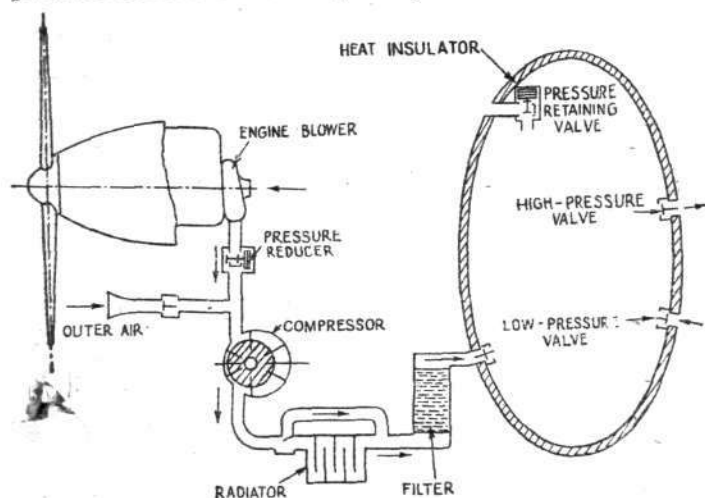


Fig. 16. Diagrammatic representation of the equipment of a pressure cabin.

prevent the pressure in the cabin from falling below the pressure of the outer air, after a high-altitude flight, and to prevent the possibility of the cabin walls being forced inwards by the external pressure, it is advisable to provide also a low-pressure valve.

### Heating Arrangements

As the outer air at great heights has a temperature of from  $-50$  deg. to  $-60$  deg. C., it is necessary to provide heating of the cabin. The simplest way of doing this is to heat the air. As a rule the temperature rise caused by the compression is sufficient. Sometimes an additional heat regulator is desirable. To keep the heat losses of the cabin down to a minimum, the walls should be provided with a heat insulator, which might be aluminium foil, and the windows should be double. As the heated air enters it first strikes the windows and thus keeps them free from misting and icing. The fundamental features of such a pressure cabin were incorporated with success in the Junkers altitude aircraft, the Ju.49, built as long ago as 1929.

### Approaching the Speed of Sound

From what has been said it emerges that speeds of 800 km/hr. (500 m.p.h.) and over are attainable within a foreseeable period. By further increase in speed, however, another limiting factor makes its appearance, which arises from an approach of the air speed to the speed of sound. When this limit is approached, the air flow round the wings is fundamentally changed. This can be most easily

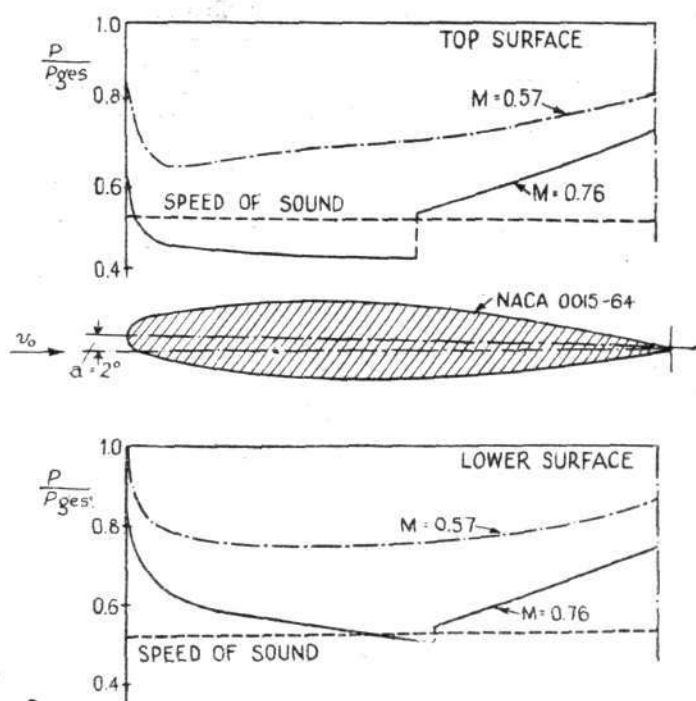


Fig. 17. Pressure distribution on N.A.C.A. 0015-64 wing section at high speeds.

appreciated by a comparison of the pressure distributions at different speeds.

The wing section shown in Fig. 17 has the pressure distribution shown in dotted lines at a Mach figure,  $M$ , of 0.57. By the Mach figure is meant the ratio of the tunnel test speed to the speed of sound. If the tunnel speed is raised, the pressure distribution becomes that shown in full lines in Fig. 17. The depression which corresponds to the attainment of the speed of sound is particularly marked. This is followed, on the top surface, by considerably exceeding the speed of sound, until a sudden rise in pressure follows; this is called the compressibility shock. After the compressibility shock the air flows on at sub-sonic speed. The pressure distribution at local super-sonic speeds is thus exactly similar to that found at sub-sonic speeds. Consequently the magnitude and location of the air resultant on the wing section must change considerably.

For constant angle of incidence the force of the air on the wing section increases approximately as the square of the speed. Its location remains the same. If, for instance, the air speed of the wing section shown in Fig. 18 is increased to 700 or 800 km/hr. (435-500 m.p.h.), then the force of the air grows correspondingly without changing its location. If one exceeds 900 km/hr. (560 m.p.h.) the resultant of the air force moves forward and becomes smaller instead of, as one would expect, greater. Even



## TOPICAL AIRCRAFT PROBLEMS

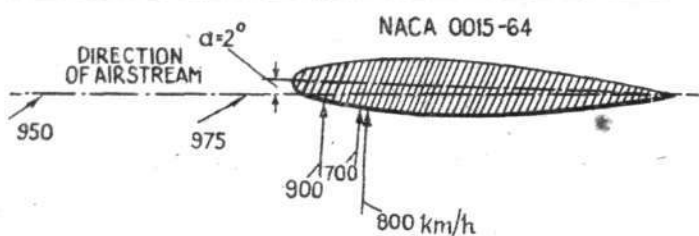


Fig. 18. Locations and magnitudes of air resultant at high speeds.

more remarkable is its behaviour at 950 km/hr. (590 m.p.h.), when it moves forward of the wing section; at 975 km/hr. (605 m.p.h.) it again moves back. Such irregular behaviour of the air resultant must react extremely unfavourably on the flying qualities of aircraft which can attain such speeds, even if only in a dive. It is the task of research to find wing sections which do not show this drawback.

In examining this illustration one is struck by the fact that the air resultant, with increasing speeds, turns more and more in the direction of the air stream; that is to say, the drag increases greatly. The reason for this increase in drag is demonstrated in Fig. 19.

### High-speed Photography

By the Schlieren method of photography, which has long been used in ballistics, it is possible to render visible the compression shocks which arise when super-sonic speeds are reached locally. In the picture such Schlieren exposures have been made of a fuselage with radiator. The picture area included in the Schlieren exposure is shown in the upper part of the illustration. In the Schlieren exposure on the left, the compression shock shows as a dark line; this is at a Mach figure of 0.80 (a speed of 0.80 times the speed of sound.—Ed.). The boundary layer appears as a narrow white band along the surface of the body. When the speed is increased to a Mach figure of  $M=0.85$ , the compressibility shock moves farther back, and the speed of sound is more greatly exceeded. After the compressibility shock, the boundary layer breaks away from the surface of the body, as can be seen from the funnel-shaped spreading of the white band. Simultaneously the drag of the complete fuselage increases by 70 per cent.

Just how high the drag of an aircraft can become has been measured in the D.V.L. high-speed wind tunnel on the model shown at the top of Fig. 20. The drag coefficient is here plotted against the Mach figure. In addition to the Mach figure are given, as a further scale, the air speeds corresponding to the Mach figures at a height of 6 km. (20,000ft.). While the drag coefficient remains practically constant for speeds up to about 700 km/hr. (435 m.p.h.),

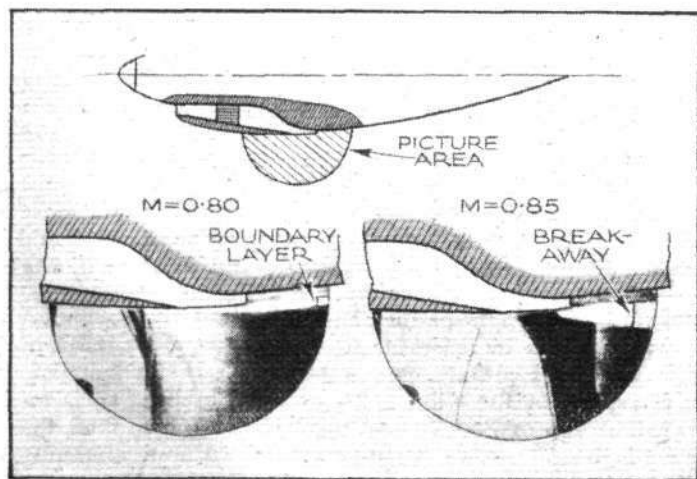


Fig. 19. Schlieren exposures of the compressibility shock and break-away of the air flow on a fuselage model with radiator.

it rises sharply from then onwards and reaches a ten-fold value at 1,000 km/hr. (620 m.p.h.). The difficulty of pressing on to such speeds is thus clearly brought out by this increase in drag coefficient.

In the foregoing we have seen that an increase in flying speed is facilitated by flying at greater heights, provided a suitable power plant is available. However, the speed of sound falls off with height, and at 12 km. (40,000ft.) it is 13 per cent., that is, 160 km/hr. (100 m.p.h.) lower than at ground level. Thus the approach to the speed of sound occurs earlier than at ground level. The requirements in this speed region thus are particularly difficult.

### The Airscrew at High Speeds

The first component of an aircraft to suffer from an approach to the speed of sound is the airscrew. That is because the tip speed of an airscrew is vectorially compounded of the rotational speed of the airscrew and the forward speed of the aircraft. In order to reduce as far as

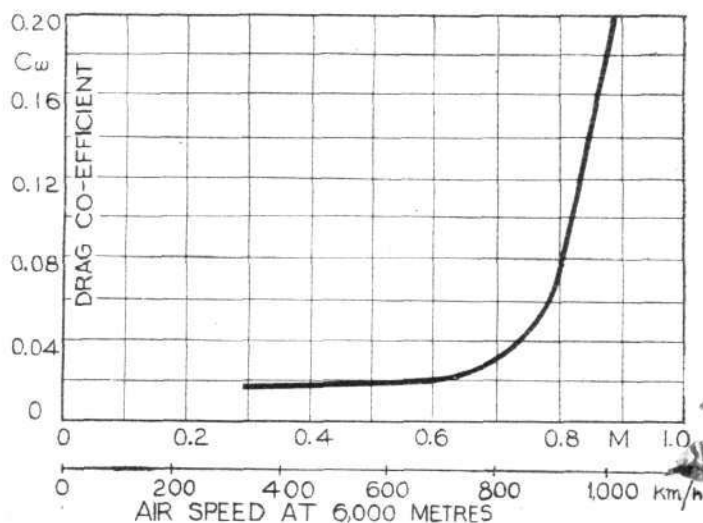
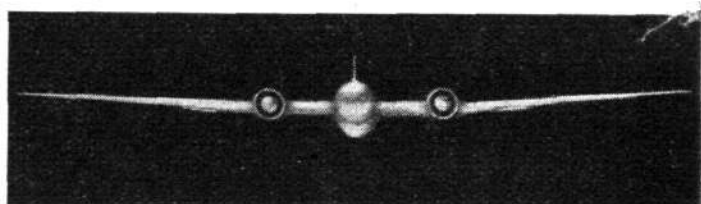


Fig. 20. Increase of drag at high speeds; from measurements on a twin-engined model in the D.V.L. high-speed wind tunnel.

possible the drop in airscrew efficiency which results from tip speeds approaching the speed of sound, we select a tip speed which is not greater than the speed of sound. From this consideration we arrive, for high flying speeds, at low revs. and coarse pitch of the airscrew blades. This results in an increase in the slip losses in the slipstream, and the efficiency falls off considerably. By the use of contra-rotating airscrews this drop in efficiency can be postponed until higher flying speeds are reached.

Estimated efficiencies of normal and contra-rotating airscrews have been calculated, and the results shown in Fig. 21. The basis is the speed factor  $v_p=0.20$ , the value most commonly found at present, and plotted against flying

speed. The speed factor formula is  $v_p = \frac{(n^2 N / \rho)^{1/2}}{W}$ , in which

$n$  is the number of revolutions of the airscrew,  $N$  the engine power,  $\rho$  the appropriate air density, and  $W$  the tip speed of the airscrew blades. The full lines apply to contra-rotating airscrews with two sets of two blades and two sets of four blades; the dotted curves refer to normal airscrews with two and four blades. If it is desired to retain an air-

screw efficiency,  $\eta$ , of at least 70 per cent., it follows that with a tip speed,  $W$ , of 320 min./sec. (1,040ft./sec.) one can go to flying speeds of about 1,000 km/hr. (620 m.p.h.) with a normal four-bladed airscrew. With two contra-rotating four-bladers the flying speed can be increased to 1,050 km/hr. (650 m.p.h.). The speed range through which a useful airscrew efficiency can be maintained is therefore increased, by the use of contra-props, by 50 km/hr. (31 m.p.h.). By using the normal four-bladed airscrew up to flying speeds of 1,050 km/hr., the efficiency would fall to some 50 per cent., i.e., 20 per cent. lower than that attainable with contra-rotating 2x4 airscrews. In addition, contra-rotating airscrews offer advantages in the attainment of good flying qualities.

The greatest objection so far advanced against the contra-rotating airscrew is the risk of flutter. Through the passage of the blades past one another a periodic air force arises, which can be estimated by calculation. The result of such a calculation is shown, for a 2x3 contra-rotating airscrew, in Fig. 22. The fore-and-aft distance between the two airscrew discs was 1.5 times the blade width. What was examined was the change in lift coefficient,  $c_a$ , for a typical blade section. According to the position of the blades, shown in the figure, the value of

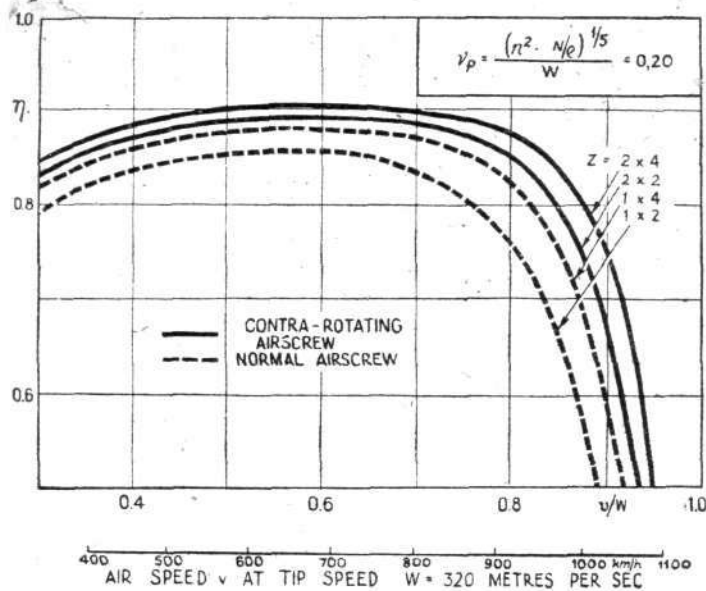


Fig. 21. Efficiencies of normal and contra-rotating airscrews at a speed factor of 0.20.

Lift coefficient varies periodically for the two halves of the airscrew. In the case of the rear airscrew there is an additional change due to the fact that the blades pass through the slipstream of the front airscrew. This additional influence is shown by dotted curves. The air force varies, according to this calculation, by some  $\pm 10$  per cent. of the mean value. Further calculations have shown that these changes fall off very rapidly with increase in the distance between the two airscrew discs. This variation of  $\pm 10$  per cent. is so small that it can safely be taken care of by suitable construction, provided blade resonance can be avoided. This ought to be possible in most cases.

#### Control at High Speeds

In the foregoing we have seen how performance can be improved. Such improvements, however, bring with them a number of other problems which the aircraft designer has to solve. We will illustrate by a few examples. In judging the flying qualities of an aircraft it is of great importance that the control forces do not exceed a certain permissible magnitude. However, the control loads necessarily increase with speed, provided the same manœuvrability is demanded of the fast aircraft.

As a measure of manœuvrability one may take, for instance, the radius of turn, or the time taken to make a 360 deg. turn. If the control forces for such a turn at a speed of 500 km/hr. (310 m.p.h.) are denoted by unity, and the control forces for higher speeds are referred to

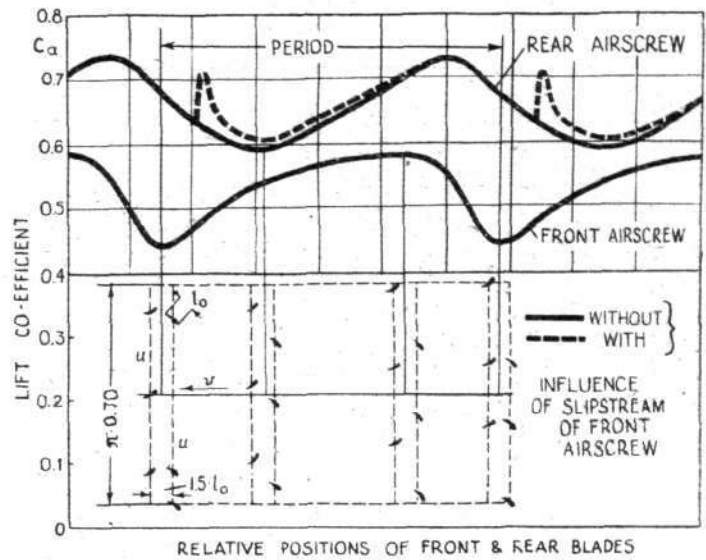
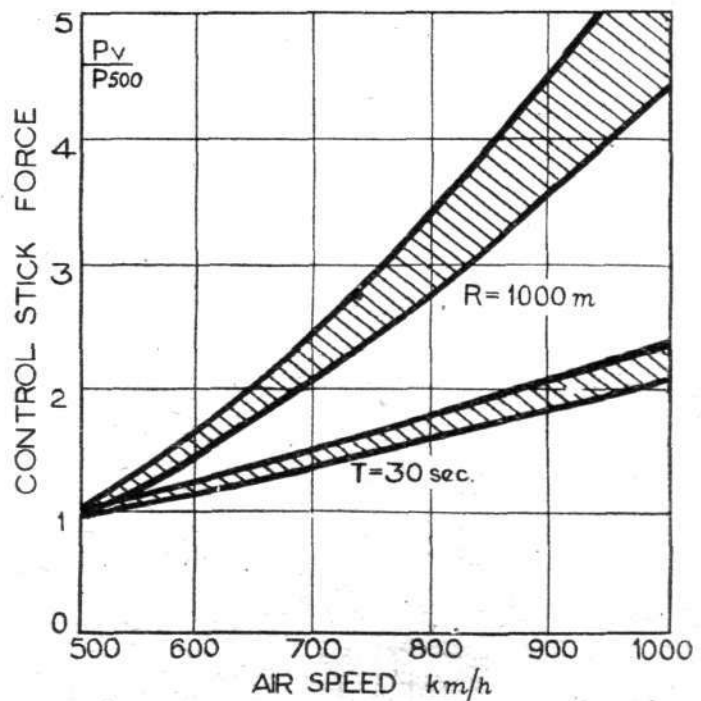


Fig. 22. Variations of lift coefficient,  $c_a$ , in a contra-rotating airscrew with 2x3 blades.

this, then we arrive at the control forces shown in Fig. 23, assuming a radius of turn of 1,000 m. (3,280ft.), or a time of turn of 30 sec. From this the control forces would, by increasing the speed to 900 km/hr. (560 m.p.h.), attain a four-fold value, provided the radius of turn were kept constant; if the time of turn were kept the same, the value would be about double.

In these calculations it is assumed that the influence of the Mach figure [ratio of speed to the speed of sound—Ed.] has not yet made itself felt, as this can vary from case to case.

The above considerations are particularly important in relation to fighters, which are frequently involved in fighting turns. In the case of bombers, special requirements arise in connection with dive bombers, which after dropping their bombs at low height must flatten out quickly (Fig. 24). This type of aircraft, long ago successfully developed by Germany, has done remarkably well in this



R=RADIUS OF TURN  
T=TIME FOR 360° TURN



Fig. 23. Increase of control forces at high speeds in a turn.



## TOPICAL AIRCRAFT PROBLEMS

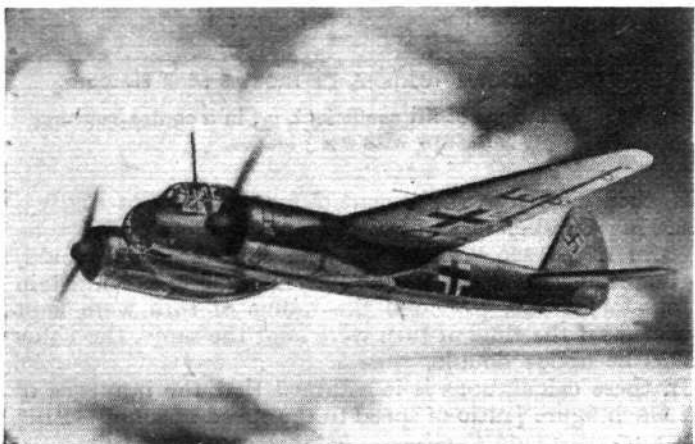


Fig. 24. German dive bombers Ju. 87 and Ju. 88.

war, but the need has arisen for increasing considerably the bomb load and range. This desire leads necessarily to a greater flying weight, such as the change-over from the Ju. 87 to the Ju. 88. If, now, one demands of heavier aircraft the same manoeuvrability, i.e., the same pull-out radius or the same time of turn, then the control forces are considerably increased.

In Fig. 25 the control forces for a "standard" aircraft of low weight are assumed equal to 1, and those for heavier aircraft referred to this. It was assumed that the heavier aircraft were geometric enlargements of the lighter, so that the similarity need only be applied to keeping the wing loading and main proportions constant. Flying speeds and pull-out radii were left unchanged.

It is seen that an enlargement of the aircraft to three times size results in control column loads of six or eight times the "standard." This loading depends on certain characteristics of the aircraft, such as the position of the c.g.

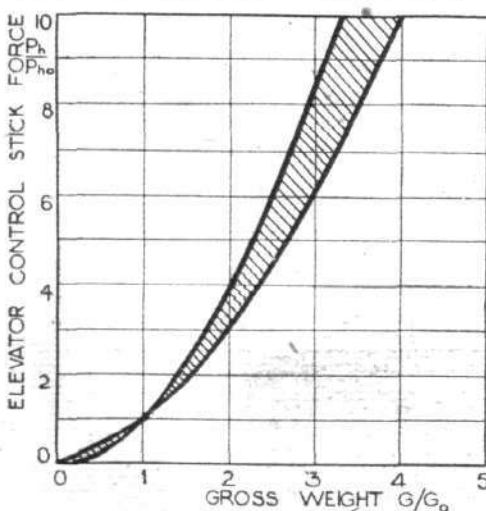


Fig. 25. Increase of control forces with increased gross weight.  $P_H$  = force on control column.  $G$  = gross weight.  $P_{H0}$  and  $G_0$  = control force and loaded weight of "standard" aircraft (taken = 1).

characteristics of the aircraft, such as the position of the c.g.

For the reasons stated, the provision of types of control surfaces which have great effectiveness combined with low-control loads becomes important. With a normal non-balanced control surface there is, when the surface is moved, a force,  $P$ , as shown in the upper part of Fig. 26, which acts on the lever arm  $l$  from the

axis. The pilot thus has to overcome, on the control column, a moment  $P \times l$ . The simplest way of reducing this moment is to set the hinge axis back, as shown at  $a$  in the lower part of Fig. 26. This reduces the lever arm of the control surface to  $l_1$ . Another possibility is shown at  $b$ . This consists of hinging to the trailing edge of the main control surface a small balance flap, so linked up that when the control surface moves down the flap moves up. The control surface moment is then the difference between two moments,  $P_1 \times l_1$  and  $P_2 \times l_2$ . Of these the main surface moment,  $P_1 \times l_1$ , is the product of a large force on a short lever arm, and the flap moment is the product of a small force on a long lever arm. Both forms of balance are currently used, and both have given good results.

Both forms of balance really have the same basic object:

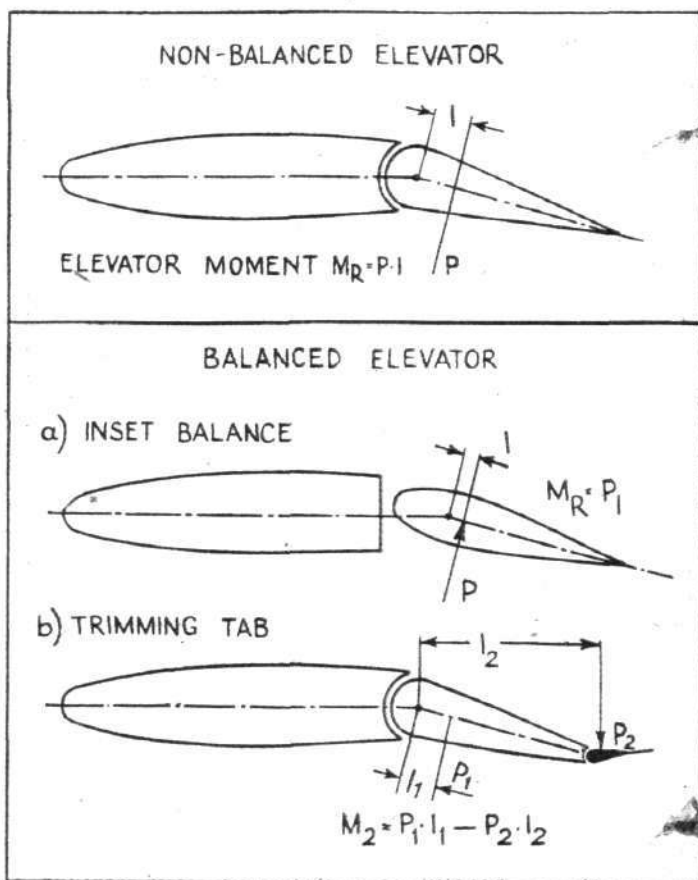


Fig. 26. Aerodynamic balances for reducing control forces.

to place the resultant air force as close to the hinge axis as possible. However, the point of application of the air resultant varies both with the angle of incidence of the tailplane and with the elevator angle itself. Consequently, it is not possible to go as far as one would like. Particularly at small elevator angles, small irregularities, or even differences in surface roughness, can shift the point of application of the air force on the control surface so far that, in the same aircraft type, one control will be normal and the other aerodynamically overbalanced. This will either cause a flicking outwards of the control surface or will start flutter.

By further increasing aircraft size, the aerodynamic balance will not suffice, and it will be necessary to go over to increasing the hand power of the pilot by some form of servo control.

## Structural Strength

The increase in flying speed imposes special requirements on the strength of the aircraft. This comes about by the fact that the accelerations to which the aircraft is subjected during the pull-out become greater with increasing speed. If we take, for example, an aircraft which is glid-

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ing along at a gliding angle of 60 deg., and is then pulled-out with a radius of turn of 500 m. (1,640 ft.), then the accelerations are as shown in the dotted line of Fig. 27. At a flying speed of 500 km/hr. (310 m.p.h.) the acceleration is 4.4 times  $g$ . At a speed of 900 km/hr. (560 m.p.h.) this would rise to 13.3  $g$ .

If one uses as a scale, not the radius of turn but the time of turn, one obtains the full-lined curve. The time of pull-out from gliding at 60 deg. to horizontal flight has been assumed as three seconds.

The increase in acceleration is then not so great as with constant pull-out radius. By going from a diving speed of 500 km/hr. (310 m.p.h.) to 900 km/hr. (560 m.p.h.) the acceleration increases from 5  $g$  to 9  $g$ . These stresses, which increase with flying speed, require extremely careful and skilled wing construction in order that, on the one hand, the weight of the wing shall not be excessive, and on the other that breakage in the air should be avoided.

#### The Risk of Flutter

Great flying speeds bring with them yet another danger which influences the construction of important parts of the aircraft in ever greater measure; this is the risk of flutter. If vibrations of wing or tail surfaces are started, for instance by a gust or by the use of control surfaces, then at low flying speeds the air forces always have a damping effect so that the vibrations decrease and die out rapidly.

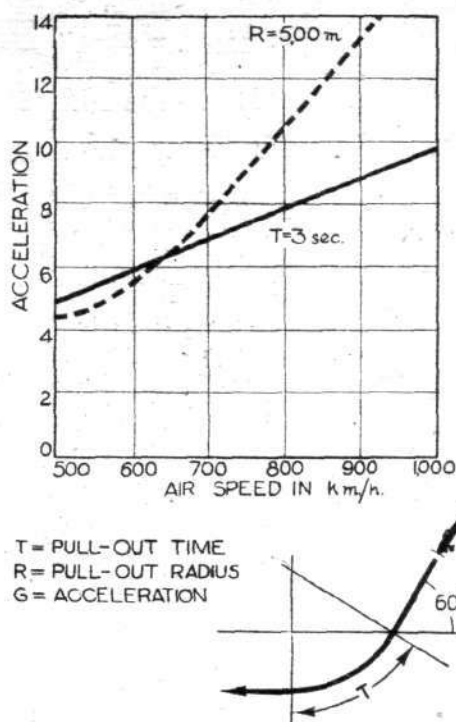


Fig. 27. Increase of acceleration during pull-out with high speeds.

With increase in flying speeds it may happen that with an unfavourable division of the elastic and aerodynamic properties of the wing or tail, this damping effect of the air forces may disappear or even change into a building-up of vibrations with increasing amplitude. A casually started vibration can then become so violent after a few beats that breakage of the aircraft follows in a very short time.

As the two examples in Fig. 28 show, an increase in amplitude of the vibrations always occurred when the air force on the vibrating wing gives a downward impulse during the upstroke and an upward impulse on the downstroke. By way of an example, the wing can simultaneously twist so that the angle of incidence increases on the upstroke and decreases on the downstroke. A similar effect occurs on a wing with aileron when the aileron moves down during an upward beat of the wing and upwards

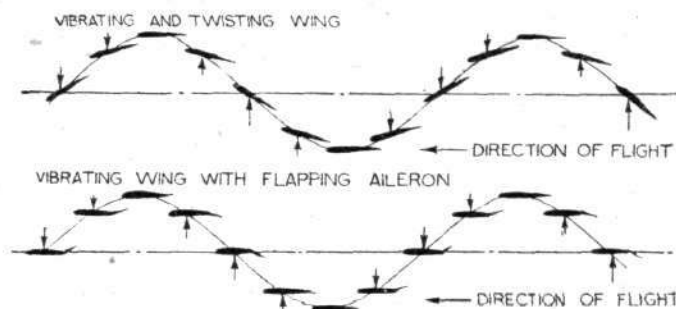


Fig. 28. Wing vibrations of increasing amplitude.

during a downward beat. It is obvious that this sort of thing can happen particularly easily when the aileron is fitted with a tab.

The occurrence of these vibrations depends largely on the locations of the centres of gravity of wing, control surface and tab. To avoid flutter it is often sufficient to shift the c.g. of the control surface, by means of a balance weight, to the hinge axis or ahead of it, instead of the more usual position of it behind the axis. Furthermore, sufficient torsional stiffness of wing or fixed tail surface, as well as ample stiffness of control rods, should also be aimed at.

From these considerations it has become necessary, already during the design stage, to calculate its vibration characteristics. However, thanks to strenuous work over many years it is now possible to keep vibrations in check. This is due partly to the perfecting of methods of calculation and partly to tests in the wind tunnel.

## BOOK REVIEWS

Three books on navigation:—"Teach Yourself Navigation," by "Kaspar," English Universities Press, 2s. 6d. "Air Navigation," by M. J. Hearley, Longmans, 5s., and "The Air Cadets' Handbook on Navigation" (Part Two), by W. J. D. Allan, George Allen and Unwin, 2s.

THERE seems to have been a veritable spate of books dealing with the somewhat complicated art of finding one's way about in the uncharted sky, and the above publications are three of the latest off the press. It is obviously inevitable that all such books should cover the same ground from an elementary explanation of maps and how to read them, via the magnetic compass and its vagaries, our old friend the (eternal) triangle of velocities, turning errors, position fixing by radio, and on into the mysteries of meteorology. Their differences lie solely in their manner of treatment and the degree of detail which their respective authors have deemed necessary.

In the first of the three books mentioned above, "Kaspar" has had in mind those of limited mathematical knowledge and has steered clear of trigonometry, but has been very comprehensive within the range he has set himself. One is surprised, incidentally, to find the English Universities Press subscribing to split infinitives, for example, "In order to evenly distribute —." However, this absence of pedantry has its advantages.

Mr. Hearley's approach to the subject is on different lines. His object is to show in simple terms some of the problems confronting the navigator of an aircraft and to supply the

solutions. He covers the more elementary aspects in longer strides and leads up to the harder problems of interception of other craft and the method of square search. Presented in a series of lessons, his book should be useful to present and potential pilots and air crews.

The third book on the list begins where Part One left off and plunges straight into the parallelogram and triangle of velocities, plotting and a survey of the errors of which the compass is guilty in varying circumstances. By the time the reader has absorbed all three books he should be able to find his way from A to B without much difficulty!

"Aerosphere," edited by Glenn D. Angle, Aircraft Publications, New York City, \$10.

ORIGINALLY published in one complete volume only, this may now also be obtained in three separate parts—*Modern Aircraft*, *Modern Aircraft Engines*, and *Buyers' Guide*, at \$6, \$3 and \$3 respectively.

The complete *Aerosphere* volume also contains a section devoted to aircraft statistics, which includes lists of world's records, and among its 948 pages of information on all phases of world-wide aeronautics are two coloured plates showing national warplane markings. Comparable with our own familiar *Jane's*, it has an appreciative foreword by Maj. Gen. H. H. Arnold, Chief of the U.S. Army Air Corps, in which he describes this well-produced American volume as "a serious and successful attempt to serve those who wish to obtain a broad perspective of the aviation industry."



# WORLD PRESS SUMMARY

## RÉSUMÉ OF TECHNICAL ARTICLES DEALING WITH AIRCRAFT AND ASSOCIATED SUBJECTS

For the summaries and translations from aircraft and technical journals of the world, we are indebted to the Directorate of Scientific Research and Technical Development, Ministry of Aircraft Production.

### Camera-Freezing

A LIST of defects in design and breakdowns in operation, on various (Russian) Service types of serial cameras is given. The main troubles due to winter conditions are freezing of the film-feed rollers, freezing of the shutter and rupture of flexible shafts.

The heating device of the camera should be carefully inspected before the flight. The heater should be adjusted to a number of temperature stages, since in view of the danger of the shutter freezing up at temperatures not requiring general heating of the camera, it is desirable to have an auxiliary heating stage for the shutter only.

*Aerial Photography in Winter. Experience of the Operation of the A.F.A. Aerial Camera Under Winter Conditions.*—(P. G. Timofiev. "Air Fleet News.") (U.S.S.R.)

### Height-Finding

IN the usual method of aerial survey, the ground is photographed from an aircraft flying at a known altitude and the resulting picture converted into a scalar map by means of special machines, provided the inclination of the optre axis of the camera with the vertical is known. It is obvious that the procedure can be reversed, i.e., if the relative position of a number of landmarks appearing on the photograph is already known from a terrestrial map, the position of the camera at the instant the photograph was taken can be determined. The author describes a simplified form of projector which will achieve this and estimates that the error in altitude is not more than 0.1 per cent. for the range 2,000 to 5,000 m., whilst angular inclination of the aircraft can be read to about  $\frac{1}{3}$  deg., provided the exposures are not taken too near the vertical. By taking a series of ground photographs each with a clock-face image giving time to  $\frac{1}{50}$  sec., the speed of aircraft between successive exposures can be calculated.

*Determination of Position and Altitude of an Aircraft in Space by Means of Photogrammetric Methods.*—(M. di Jordis, Atti di Guidonia (Italy).)

### Lifting Airscrews

THE paper examines the aerodynamic forces and gyratory motion of the hinged blades of an auto-rotating autogyro or helicopter screw for the case when the axis, besides a transitory motion, has uniform rotation with respect to a system of fixed co-ordinates.

Such motion takes place when the aircraft has attained a state of uniform, curvilinear motion, e.g., when banking, looping or rolling, or in the case of oscillations about the longitudinal or transverse axes.

Analysis shows that in the case of curvilinear motion the gyratory motion of the rotor blades varies in the sense that the axis of the cone described by the blades in space lags behind the axis of the rotor and is inclined to the perpendicular by an amount proportional to the ratio between the angular velocity of rotation of the aircraft  $\Omega$  and the angular velocity of rotation of the rotor  $\omega$ .

The position of the resultant aerodynamic force varies in accordance with this. Contrary to the established opinion, this resultant is deflected in the direction opposite to the direction of rotation, i.e., lags behind the rotor axis and thus produces a damping moment relatively to the centre of gravity of the aircraft, which opposes the rotary motion.

The direction of this lag is phase-displaced with regard to the angular velocity, as a consequence of which the angle of incidence of the rotor is changed in the case of transverse rotation of the aircraft.

The effect of this phenomenon together with the effect of the increase in the angles of incidence of the individual blade-

sections occurring in curvilinear motion is examined in as far as it affects the auto-rotation and the manoeuvrability.

Furthermore, the effect of the nature of the profiles and method of centring of the blades on the above phenomena is examined.

A comparison is made of the theoretical calculations with the results of wind tunnel experiments, which show good agreement.

In conclusion, data are given on the essential parameters ensuring stability and safety of the rotor.

*The Aerodynamics of the Lifting Airscrew with Hinged Blades in Curvilinear Motion.*—(M.L. Miehl, U.S.S.R.)

### Towed Gliders

THE type of glider used as a German troop carrier in Crete has a wing span of 21.3 metres and wing area of 27 metres.<sup>2</sup> It is capable of carrying eight soldiers, and has a weight of 900 kg. including crew. When abandoned, its greatest speed of descent is only 1.22 m. per sec. This, however, enables it to manoeuvre a suitable landing position and to choose its site, which the parachutist is unable to do, and comes to rest safely on its spring keel. Contrary to belief, the speed of the towing aircraft is hardly affected by the glider train.

The Junkers Ju 52, used as a tug in the war against Crete, is an adaption of the civil version which can carry up to 17 passengers. It has been employed extensively in Norway and Holland for transport of troops and in Libya for refuelling purposes. It is capable of towing a train of from three to six gliders, which carry crews totalling twenty-four to forty-eight.

The four-engined Focke-Wulf "Kurier" has a wide radius of action and plays a very active part in the Atlantic region in waging war on British convoys. This machine can tow a train of eight to ten gliders, carrying crews of 64-80 men.

*Gliders, as Troop Carriers, in the War Against Crete.*—("La Science et la Vie.")

AIRCRAFT towing as a method for launching high-performance gliders is a relatively recent development. Up to now, no specially designed aircraft "tug" has become available, but for this purpose a number of different types of training and civil aircraft have been used indiscriminately. In these cases the two rope is attached to the tail of the tug, which experiences considerable pitching moments if the trailer rises much above or falls much below the level of the tug. A tendency of the glider to rise above the tug is especially difficult to avoid if the glider pilot has been accustomed to "winch" starts where a rapid gain in altitude is essential.

Flying the tug thus requires constant attention, and even then pitching oscillation of the train occasionally arises, which reaches dangerous amplitude and requires a premature release.

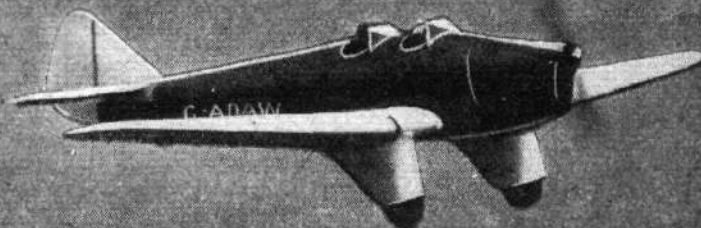
The authors of this article, who are the designers of the tailless aircraft "Horten V," suggest that this type lends itself particularly for towing gliders, since the cable can be attached near the C.G. of the aircraft and all pitching moments avoided. After a short review of the special flying requirements of aircraft tug (low landing speed, very high rate of climb at steep angles when operating near the ground, excellent field of view, etc.) the authors put forward a design for a twin-engined tailless aircraft weighing about 2,000 Kg. with a span of 16 m. The engines total 500 h.p. It is claimed that, whilst towing two gliders of 1,000 Kg. each, such a machine would have a rate of climb of about 5 m./sec. and a horizontal towing speed of 150 m.p.h.

It should be emphasised that the proposed tug is intended mainly for launching gliders in competitions or for training and research. Under these conditions the actual flying time of the tug is short, the intention being to make as many launchings as possible in a given time.

*Proposal for the Development of a Towing Aircraft (Tug).*—(Geb. Horten, D.M.2.Z.)

# Milestones ...

# 1934/5



MILES 'MERLIN'  
MILES 'FALCON'  
MILES 'HAWK MAJOR'

## Stages in the development of a reputation

AFTER the success of the Hawk in 1933 had justified the designers' belief in the low-wing monoplane, other aeroplanes quickly followed. They were the first British aeroplanes to standardise split flaps, which provided full control at very slow landing speeds.

HAWK MAJOR Two-seater (bottom). — The prototype of this famous plane, fitted with a Gipsy III engine, was flown by Tommy Rose in the 1934 King's Cup Race, gaining a popular second. MacGregor and Walker flew a Hawk Major from England to Australia in five days, fifteen hours, a single-engine record that stands to-day.

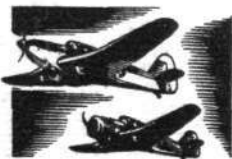
FALCON Four-seater (centre). — This was the designers' first real cabin aeroplane, but in all other respects was similar to the Hawk Major. Fitted with a Gipsy VI engine, a Falcon was piloted to victory by Tommy Rose in the 1935

King's Cup Race. Two Hawk Trainers also secured second and third places. A Miles Aircraft Sparrowhawk completed an outstanding day by winning the speed prize, and was first to finish, although unplaced on handicap time.

MERLIN Five-seater (top). — Built to the specification of Birkett Airways to carry a pilot, four passengers and luggage with a 200-h.p. engine, this aeroplane, developed from the Falcon, was soon flying on regular services at home and abroad.

It was during this period that Phillips & Powis Aircraft, Ltd., became a public company.

The experience behind Miles Aircraft design was then devoted to the building of Service aircraft, a policy which resulted in the now-famous Miles Master — fast advanced Monoplane Trainer for the Monoplane Pilots of the R.A.F.



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NAPIER

ENGINES

# IN PARLIAMENT

Extracts from the Official Records of Proceedings in the House on Matters of Interest to the Air Forces and Aircraft Industry

## Privilege Leave Travel Warrants

*Wing-Commander Hulbert* asked the Secretary of State for Air whether Royal Air Force personnel, when proceeding on seven days' leave, are entitled to receive a free railway warrant between their station and any destination in the United Kingdom, or whether such warrants are restricted to journeys between an airman's station and his home address.

*Captain Balfour*: Commanding Officers have discretion in connection with privilege leave to issue warrants to any place in the British Isles if good reason is shown. This discretion is widely exercised.

## Misuse of Skilled Fitters

*Sir H. Williams* asked the Secretary of State for Air whether his attention has been drawn to the fact that some 60 aircraft fitters have recently been posted from an operational unit to a recruiting centre, at a station of which he has been informed, for the purpose of being trained as infantrymen; and whether this misuse of skilled engineering personnel was made with his knowledge.

*Sir A. Sinclair*: These airmen are not being trained as infantrymen, but are receiving instruction in ground defence duties.

*Sir H. Williams*: Will my right hon. Friend make further enquiries into this matter, as owing to the nature of his answer I do not think he has appreciated the facts?

*Sir A. Sinclair*: If the hon. Member will give me any further information, I will look into it, but I am informed that these men are in fact following a course which will fit them for special airdrome defence work.

*Mr. A. Edwards*: Is the Minister aware that his Department has spent 12 months converting an employee of mine, who is a first-class accountant, into a third-rate mechanic?

## Books for Airmen

*Mr. Lipson* asked the Secretary of State for Air whether he is satisfied that adequate provision is made at all Royal Air Force stations in this country for a supply of books.

*Sir A. Sinclair*: Every endeavour has been made and is being made to ensure that, despite the shortage of paper, a liberal and varied supply of reading matter is available at R.A.F. stations. Apart from recreational and other books provided at public expense, valuable help is received from the Services Libraries and Books Fund which welcomes gifts of new or second-hand books and magazines from the public generally.

*Mr. Lipson*: Will my right hon. Friend say who is responsible for providing books at stations, and will he take note of the fact that the other day an airman to whom I gave a lift told me that he had to go several miles to buy a book, and that there were none at all at his station, which was a big one?

*Sir A. Sinclair*: They are supplied by

the Ministry, and arrangements have been made. If the hon. Member will give me particulars, I will be very glad to look into them.

*Mr. Pickthorn*: Can my right hon. Friend say what proportion of the books is "liberal" and what proportion of the books is "varied"?

## Airmen Chosen for Overseas

*Mr. Messer* asked the Secretary of State for Air why it is necessary for married men with only three months' service to be sent overseas whilst single men with 12 months' and more service are retained in this country?

*The Joint Under-Secretary of State for Air (Captain Harold Balfour)*: The considerations governing the selection of airmen for duty overseas are, on the one hand, the rank, trade and particular experience required in the overseas establishment and, on the other, the need to maintain the efficiency of units at home. In view of the large number of postings, it is in general necessary to leave the selection to the discretion of Commanding Officers. If, however, an airman feels that on compassionate grounds he should not proceed overseas, he can submit an application to this effect to his Commanding Officer.

*Mr. Messer*: Irrespective of the question of compassionate grounds, is it not a fact that there is a large number of untrained men who have only had three months in the Air Force, while there are similar men who have been detained in the country and have been in the Air Force for 12 months?

*Captain Balfour*: The efficiency of a unit and the functions that it has to perform play an important part in the consideration of who shall go abroad. Thus all men, even of the same rank or the same experience, cannot be given equal treatment as regards fulfilling our overseas requirements for skilled men which are urgent.

*Mr. Messer*: Then I am to take it that efficiency is improved by unskilled men going abroad?

*Captain Balfour*: Certainly, if in certain units skilled men are kept at home, thus keeping up the efficiency of their particular units here.

## W.A.A.F. Police Should Drink

*Colonel Medlicott* asked the Secretary of State for Air whether he will withdraw or amend the rule that applicants for appointment as police officers in the Women's Auxiliary Air Force must be moderate drinkers and not total abstainers.

*Sir A. Sinclair*: I would refer my hon. and gallant Friend to the reply on this subject which I gave to the hon. Member for Westhoughton (Mr. Rhys Davies) on February 24th. I see no reason for altering the present arrangements.

*Colonel Medlicott*: Is my right hon. Friend aware that this regulation applies primarily to young people, and that by it official encouragement has been given to those who drink rather than to those who abstain, and does he not regard this as an unfortunate and retrograde step?

*Sir A. Sinclair*: I would not call it giving encouragement to those who drink. It does, however, enable these women to carry out their functions more efficiently if they are able to mix with women who are not total abstainers.

*Colonel Medlicott*: Is it not a fact that total abstinence is not a disability, and that this rule does in fact place total abstainers at a great disadvantage?

*Sir A. Sinclair*: I do not think so. It is not laid down that they must on no account be total abstainers. If there is a total abstainer who is in every other respect perfectly suitable, there would be nothing to prevent her being appointed, but, other things being equal, it is an advantage that they should not be total abstainers. [Interruption.]

*Mr. George Griffiths*: I beg to give notice that I shall raise this matter on the Adjournment. It is a most disgraceful thing; it is a shame.

## Skilled Workers Transferred

*Mr. Gallacher* asked the Minister of Aircraft Production whether he has considered a telegram from a certain factory committee drawing attention to the impending dismissal of more than 100 skilled workers, when maximum production is required; and what steps is he prepared to take on the matter.

*The Minister of Aircraft Production (Col. Llewellyn)*: Some skilled workers will unavoidably become redundant at this factory while a new type of equipment is getting into production. In conjunction with the Ministry of Labour, arrangements are being made for this labour to be suitably employed elsewhere.

*Mr. Gallacher*: Why is it that there is never any consultation with the men in the factories, who are the most important factor in questions of this character? Have the men always to be treated as untouchables by the big white bosses up above?

*Col. Llewellyn*: No, certainly not, but it is a fact that the order for the type of store that was being made there has been finished, and there is no prospect of a further order for that type. I have seen that another order of another type has been given, but before the factory can be used for that there is some redundant labour. As we very much need it elsewhere for radio equipment, it will be transferred elsewhere and will still be doing very good service for the country.

*Mr. Gallacher*: Will the Minister not face up to the point as to why the men, who are the most important factor as far as production is concerned, were not consulted and advised on the situation in the factory, and of the necessity for any change that had to be made?

*Col. Llewellyn*: I think it would be well if they were advised. In fact, I went to two or three factories myself, and took the opportunity of explaining to the men what was happening. I think it is a good thing to keep them informed.

*Mr. Davidson*: Will the Minister communicate with managements of factories in that sense?



# HERE AND THERE

## Civil Air Patrol

**A**N American Civil Air Patrol composed of some 280,000 pilots, student pilots and ground personnel, to enlist for the duration of the war, has been established by New York's famous mayor, F. H. LaGuardia, who is director of the "Office of Civil Defence."

The ranks will be composed of 90,000 already licensed pilots, the same number of student pilots (presumably to be instructed under the Civil Aeronautics Administration's civilian pilot training scheme) and some 100,000 technicians.

The Patrol, which sounds very much like our own ill-fated Civil Air Guard of pre-war days, will have about 23,000 civil aircraft and 2,000 airports in the U.S.A. on which there are no military or scheduled aircraft operations.

A sort of Civil Air LaGuardia, in fact!

## A.T.C. 180,000 Strong

**T**HE latest figures for the A.T.C. show that the Corps is now nearly 180,000 strong. This was announced by Mr. W. W. Wakefield, M.P., Director of the A.T.C., during an inspection of A.T.C. units. Mr. Wakefield stated that the figure was still increasing, despite the numbers passing into the Royal Air Force.

Moreover, the training given to the youth of Britain in the A.T.C. was one of the most constructive things in a world where so much destruction was going on.

The things cadets learnt about engines, radio, communications, calculations, and navigation would be of great value to them in their post-war life.

Already, added the director, many cadets have found their A.T.C. training of practical value to them in their ordinary daily work.

## Student Engineers Dine

**A**BOUT 100 students of the City and Guilds College attended the annual dinner of their Engineering Society last week, at which their president, Dr. A. P. M. Fleming, C.B.E., himself an old Guilds student, presided.

This was the society's third wartime dinner held at Slater's, Kensington, and the hon. secretary, B. A. Jarrett, said that it marked the conclusion of another successful season during which student papers had largely been relied upon; these, by the way, included one on wind tunnels.

Major G. C. Lowry, who proposed the toast of the Society, stressed the point that it would be up to the coming scientists and engineers to see that their knowledge was in future used to benefit mankind instead of being put to wrong ends by the industrial world as in the past, and he caused some amusement when he claimed that only about 10 per cent. of the human species possessed "well-ordered minds."

## Another Fund Record

**W**ITH a total of nearly £44,000 now reached, the R.A.F. Pilots and Crews Fund, launched by the Auctioneers' and Estate Agents' Institute just over a year ago, has already passed the total achieved by the Institute's "Star and Garter Fund" of the 1914-18 war.

In the last war the Star and Garter Fund raised the sum of £43,254. With this money the site of the Star and Garter Home for Disabled Sailors, Soldiers, and Airmen was bought, and over £14,000 was contributed towards its endowment.

That fine total of £43,254 has just been passed by the Institute's R.A.F. Pilots and Crews Fund. The arrival at Knole, Sevenoaks, of a cheque for £400, being part of moneys raised by the East Anglian branch, brought the total received at headquarters to £43,600.

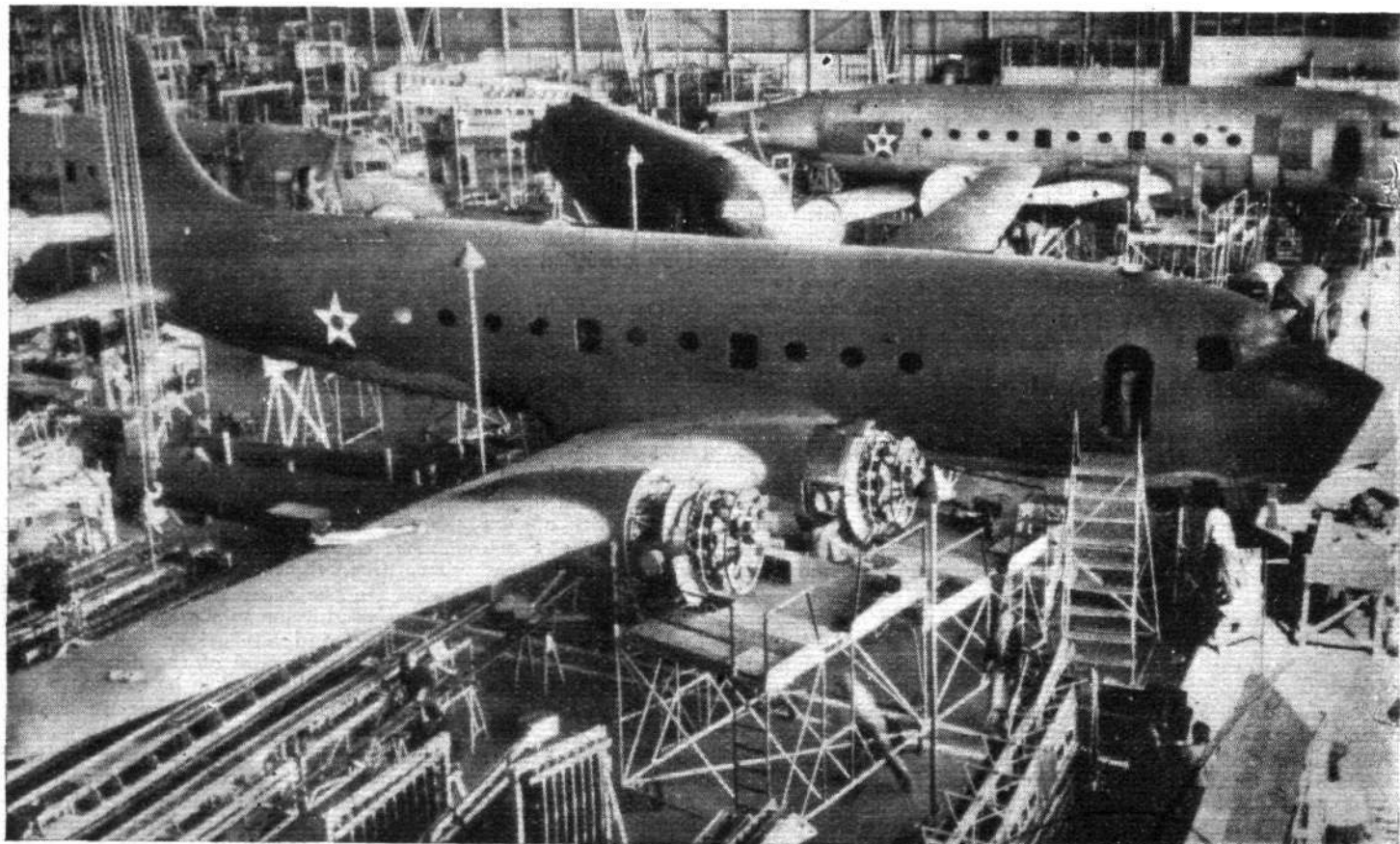
## Lectures for Women Supervisors

**C**COURSES of lectures on the work of women supervisors are to be organised at technical colleges throughout the country by the Ministry of Labour and National Service in conjunction with the Board of Education and the Scottish Education Department.

These will be free, but only existing women supervisors and others who have had not less than six months' experience in industry will be accepted, and the establishment of a course in any particular locality will depend on there being sufficient local demand.

The lectures, each of which will last about two hours, will be held outside working hours and will cover such subjects as the general principles of workshop supervision, factory organisation, timekeeping and payment, and factory legislation, including special wartime measures.

Employers are invited to put forward suitable women, and the names and addresses of women applying for the course should be sent to the local Labour Exchange.



**MAMMOTHS IN THE MAKING:** A general view of the Douglas assembly shop at Santa Monica, where the big four-engined C-54 troop transports are seen nearing completion. The type was originally intended for commercial use.

*Whole World*

*Thirty-second of the Second Series***FRIEND or FOE?**

*Sisters Under the Stressed Skin :  
Flying Fortresses I and II*

**A** PART from the vastly improved armament, the Boeing B-17E (Fortress II) differs from the original B-17 (Fortress I) in its general outline nowhere more obviously than in its tail design, as a glance at

the accompanying illustrations will show.

The fuselage of the Fortress I terminated in a point, and the vertical surfaces, which had a straight, steeply sloping leading-edge, were composed of about one-third fin and two-thirds rudder, the latter having a rounded apex which curved into an almost vertical trailing-edge ending flush with the fuselage extremity. No "stinger" turret was fitted, but there were gun blisters just forward of the tailplane.

The Fortress II, however, has a completely redesigned tail group, and although the most important difference is the inclusion of a gun-turret in the tail, the most obvious change lies in the vastly increased fin area, which now begins almost amidships and, after rising on a gradual slope to a point about level with the leading-edge of the tailplane, then curves steeply up to a uniformly rounded apex. The rudder, which now forms appreciably less than half the total vertical area, has a slightly curved trailing-edge and ends immediately above the "stinger" turret.

Tailplane dimensions are also considerably modified; on the Fortress I it was of moderate aspect-ratio and had a sharply backswept leading-edge, a slightly curved trailing-edge and rounded tips. The latest design, however, is of high aspect-ratio, having a chord some eight per cent. less at the roots, and an increase of nearly 25 per cent. in its

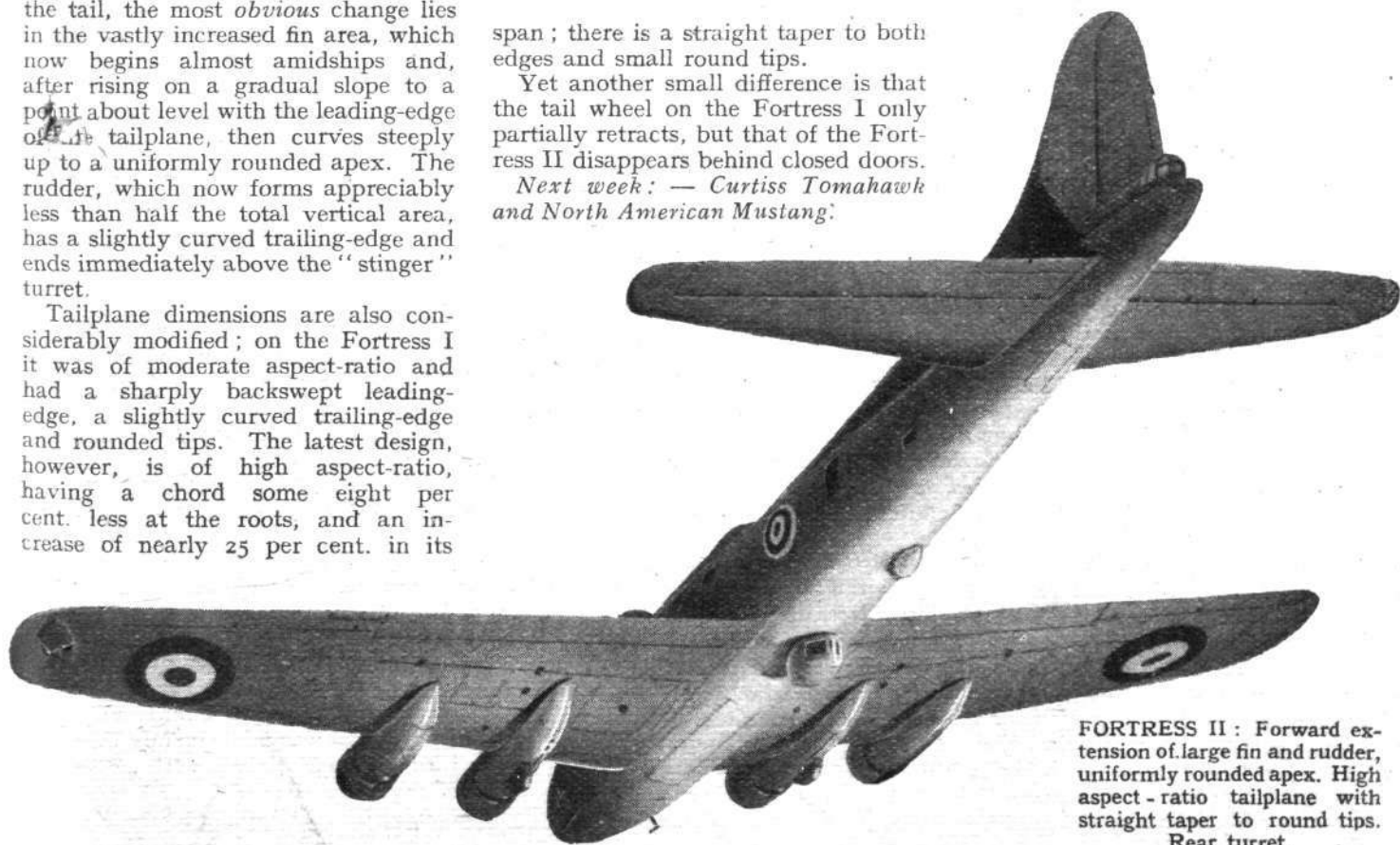
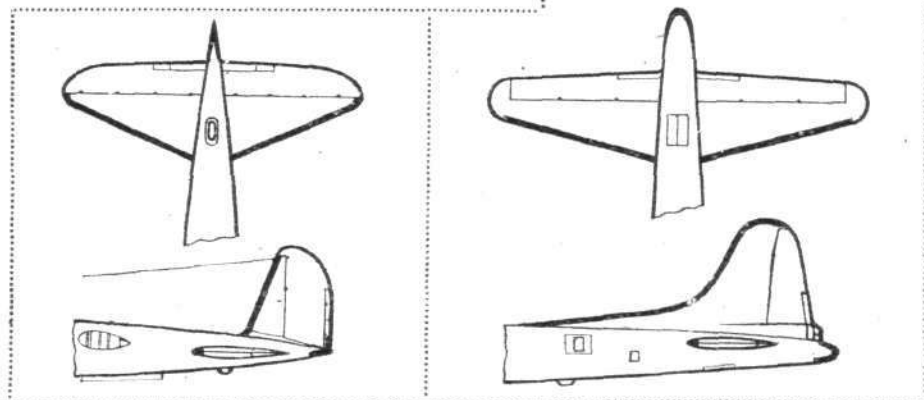
span; there is a straight taper to both edges and small round tips.

Yet another small difference is that the tail wheel on the Fortress I only partially retracts, but that of the Fortress II disappears behind closed doors.

*Next week: — Curtiss Tomahawk and North American Mustang.*

**FORTRESS I:** Straight steep slope to leading-edge of fin, curved apex and trailing-edge to rudder. Sharply backswept leading-edge to tailplane; no rear turret.

(Left) FORTRESS I  
(Right) FORTRESS II



**FORTRESS II:** Forward extension of large fin and rudder, uniformly rounded apex. High aspect-ratio tailplane with straight taper to round tips. Rear turret.



# THE FUTURE OF CIVIL AVIATION

*Its Importance Now Realised : Deciding on the Right Policy : The Political Aspect : As Little Government Interference as Possible*

By "PLANTHAIR"

EVERYONE seems to be persuaded that civil aviation will occupy as important a place in the scheme of things in the post-war world as any other form of transport or communication—if, indeed, it does not prove to be the most important.

It is certain in the reconstruction period, when difficulties of transport and communication will be at their worst, aviation will be the only means of rapid international transport.

Those who have always believed in the future of civil aviation are not particularly surprised at this general recognition of what they thought was self-evident, but they feel that it was a tragedy that some of the support which is now being given to it was not available before the war. They feel, too, that, at the outbreak of war, civil aviation had a raw deal.

## American Contrast

In America, civil air training has been expanded and used to help the war effort, but in this country it seemed to be the general desire in official quarters to stamp it out as quickly as possible rather than to accept any help it might give. This was in spite of the fact that the Civil Air Guard training scheme had, we thought, been instituted for the purpose of assisting preliminary training for the Royal Air Force.

It is true that at the present moment civil aviation seems to be recovering, and to be likely, if the war lasts long enough, to be allowed to perform a useful function. Our present interest, however, should not be the neglect it has suffered in the past, but the possibilities of the future, and we who know something of the history of British civil aviation, and who have some interest in it, would be doing less than our duty if we did not try to imprint on the picture of things to come the shape which we think it ought to take.

We have seen so many mistakes made in the past that we should surely be able to suggest how they might be avoided in the future. It is not my purpose in these articles to argue particularly for or against certain courses of action, but rather to try to show the advantages and disadvantages of the alternatives which may be open to us in the hope that those responsible for the future of British civil aviation will see that it takes its proper place in the world and serves the best interest of the nation.

It is impossible to foresee the set-up of post-war civil aviation clearly enough to make it worth while to discuss detail plans for the whole, or even part of it. All that we can do, or ought to do at this stage, is to decide, if we can, the right policy that should be adopted; and, having done this, leave the details to be filled in later by those with particular knowledge and experience.

It seems to me that, in the past, we have been too prone to leave matters of policy to someone else and to grumble heartily if things went wrong. This was probably because each was too intent on his own particular interest and was unwilling to subjugate that interest to the good of civil aviation as a whole if this was necessary. It is too much to expect that individuals will sacrifice their own interests for the common good; but if the broad lines of the policy are right they will have no choice.

The history of civil aviation before the war was one of muddle and neglect, and every reader of this paper who is interested in the future welfare of British civil aviation (and few are not) should do what they can to see that the record of the next 20 years is better than the past.

In order to appreciate the present position, it is worth while to glance at the arrangements of the political direc-

tion of civil aviation in the period between the Great Wars. Civil aviation started officially in April, 1919. At that time Winston Churchill was Secretary of State for War and Air, with Major-General Seeley Under-Secretary of State for Air. The Department of Civil Aviation had a Controller-General in the person of Major-General Sir Frederick Sykes.

This arrangement lasted until 1922, when Sir Sefton Brancker was appointed Director of Civil Aviation. Sir Frederick Sykes, as Controller-General, had had a seat on the Air Council, but Sir Sefton Brancker was not a member of the Air Council, although he reported to it.

After Brancker's death in the accident to the R101, in 1930, Sir Francis Sheldermine was appointed Director of Civil Aviation. In 1935 it was decided to raise the status of the position and he was made Director-General. This was an equivalent rank to a member of the Air Council. He was allowed to report direct to the Air Minister instead of to the Air Council.

This move was obviously made to strengthen the department and three years later, in 1938, a Permanent Under-Secretary to the department was appointed as a result of the recommendations of the Cadman Committee. The object of this was, again, to fortify the position of the Director-General, and it was visualised that he and the Permanent Under-Secretary would be able to make strong representation of civil aviation affairs to the Secretary of State for Air.

It was agreed at this time that the Under-Secretary of State for Air would make civil aviation his particular interest, and, in times of peace, he would no doubt do so. The present Under-Secretary, for instance, is, by his experience, well fitted to represent civil aviation in Parliament.

The weakness of the position was that the ultimate reference was to the Secretary of State, and, further, either in peace or war, his primary interest was the Royal Air Force. Civil aviation in the past came to be regarded as the "poor relation" of service aviation and had to be content with the "crumbs that fell from the rich man's table."

## Shocking State of Muddle

This is the main objection to the present arrangement, and that it is a cogent one is demonstrated by the results, if we judge from pre-war civil aviation.

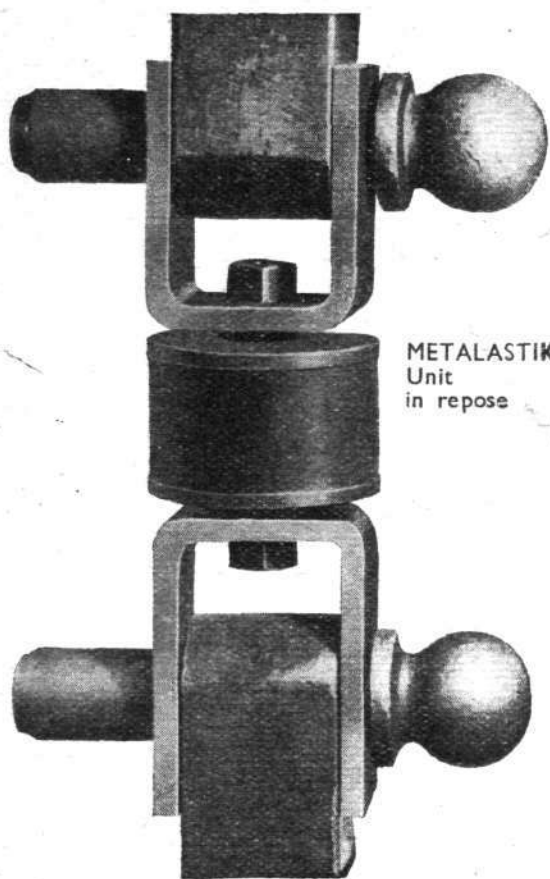
From the political point of view it suffered then from neglect relieved by spasmodic bursts of political interest which did it more harm than good. Things were allowed to get into a shocking state of muddle until some Member of Parliament suddenly realised that British civil aviation was, as one described it, "a laughing stock" in other countries.

Having realised this, Parliament set up a Committee which made most drastic recommendations. The inter-war history of civil aviation is sprinkled with the reports of committees, the recommendations of which were very often inconsistent and in some cases practically impossible to carry out.

Just before the war, there was a strong feeling that civil aviation would never have a consistent policy so long as it was in the position of a poor relation of service aviation, and that those responsible for other forms of transport should also be made responsible for civil aviation.

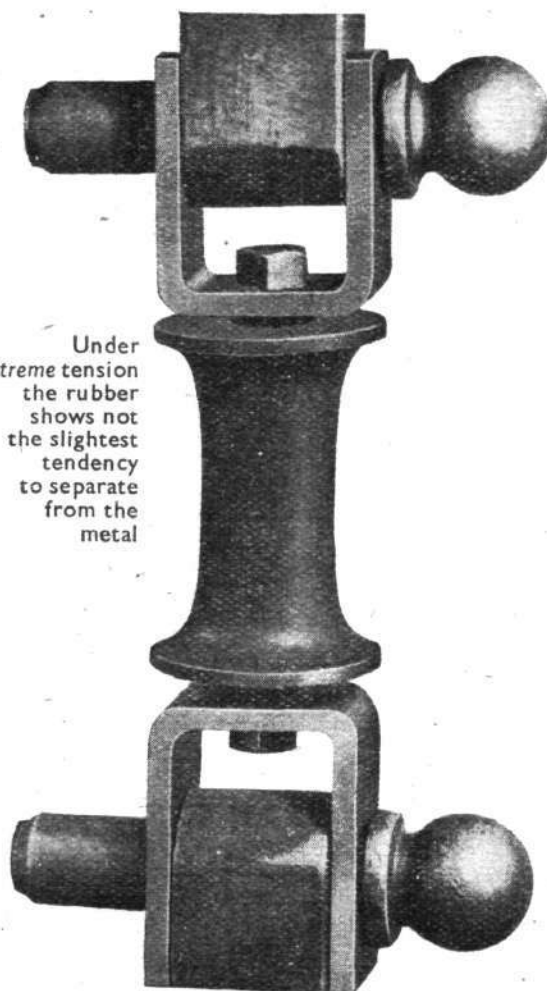
At one time it was suggested that the Board of Trade should adopt it, and this proposal was made mainly because the Board of Trade, through its Marine Department, had very efficiently done all that was required of a government department in connection with British shipping.

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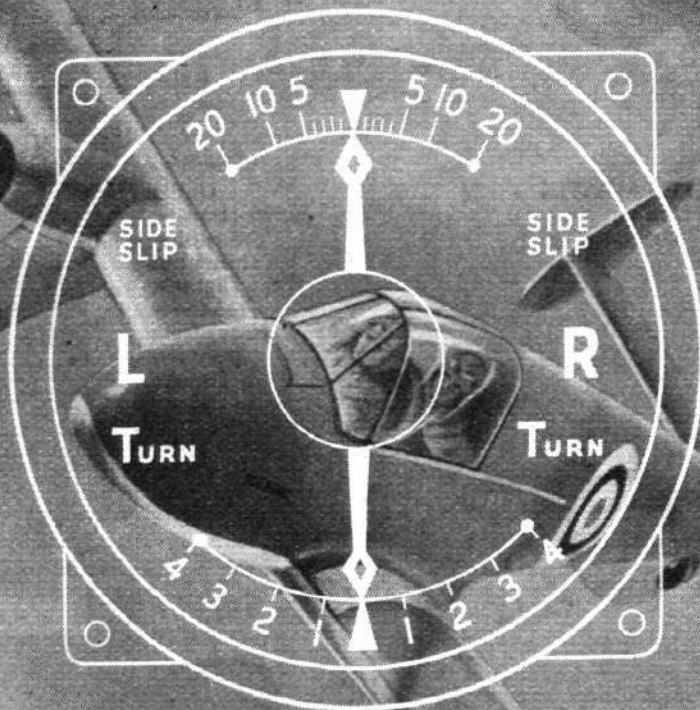
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## THE FUTURE OF CIVIL AVIATION

The position of shipping was, indeed, instanced as a good example for aviation to follow. It was entirely divorced from any Admiralty influence, government control was reduced to the minimum necessary to ensure the safety of the travelling public, and the ship-owner was able to carry on his legitimate business without unnecessary interference. The Marine Department of the Board of Trade was, in fact, of great assistance to him and, in conjunction with the Shipping Registers—Lloyd's and the British Corporation—helped to make the standard of safety and seaworthiness of British ships the highest in the world.

This may have been a good example to imitate, but there was no real reason why the Board of Trade should interest itself in aviation. In any case, the position has now changed, because the Department of the Board of Trade which dealt with shipping has been incorporated in the Ministry of Transport and it seems unlikely that the old position will be revived.

### Its Logical Place

The Ministry of Transport seems to be the logical place for air, sea, rail and road transport, but the important aspect to bear in mind is that the less government interference with any industry, the more efficient that industry is likely to be. This applies irrespective of whether the industry, or part of it, is publicly owned. We should not forget that within the framework of the regulations which governed it, the Department of Civil Aviation was well run and assisted British civil aviation when and how it could.

We have recently seen a public attack on the efficiency of the ex-Director-General, Sir Francis Sheldermine, which was to a large extent quite unjustified. The truth is that the blame for what was wrong with pre-war civil aviation can be laid entirely at the doors of the politicians; the head of the Department, as a Civil Servant, merely carries out the wishes of Parliament.

Although the Civil Service is a wonderfully efficient institution, people forget that it was never intended to be an executive body. The power of actually doing things is in the hands of the representatives of the people, that is, Parliament and its officers. The Civil Service is there to see that things are done in accordance with the wishes of Parliament as expressed in Acts and Regulations. It is not fair, therefore, to expect them to show initiative or executive powers, and we would, for instance, be very unwise to expect the Civil Service to operate aircraft with any semblance of efficiency.

These considerations naturally lead to the suggestion that the Department of Civil Aviation should concern itself only with seeing that the expressed wishes of Parliament are carried out, and with giving the aircraft operator any assistance that he may require in respect of international agreements, or permits to fly over foreign territory.

In the past, the Department has attempted to do far too much detail work which it could do neither efficiently nor economically. This detail administration work should be left to recognised bodies allowed to do it in their own fashion untrammelled by the necessarily detailed methods of the Civil Service, and responsible for its efficient doing to the Under-Secretary of State for Air.

Some people have suggested that civil aviation will be of sufficient importance in the post-war world to have its own Minister, and that we should press for a Minister of Civil Aviation, who presumably would be responsible to the Cabinet. Although civil aviation will undoubtedly play a very important part in future world communications, it seems more likely that Parliament would decide that all forms of transport should come under the same minister, and that each particular form should be represented by an Under-Secretary of State. There would, no doubt, be friendly rivalry and competition between these Under-Secretaries for the ear of the Minister on various matters which might affect their departments, but this is quite a different position from that which has held in the past, when a civil department had to fight for its existence against a service department, the claims of which must obviously be paramount in certain conditions.

I suggest that the ideal political set-up after the war should be an Under-Secretary of State, whose concern is solely civil aviation, assisted by a Director-General and a comparatively small Department of Civil Aviation consisting mainly of senior officials whose duty it would be (apart from seeing that the wishes of Parliament were met) to assist the development of British civil aviation both at home and abroad. The detail administration should be left to what have been termed the Government's "chosen instruments." These chosen instruments would not, of course, be profit-making concerns, but in the nature of what we now know as "public utility bodies."

One general requirement of post-war civil aviation is essential—it must from the very beginning have a reasonably fixed policy and be allowed to develop within that framework.

After the last war it was first decided that civil aviation should fly by itself. When this was shown to be impossible, and after the attempt had reduced the status of civil aviation abroad below the level which Parliament thought was tolerable, they decided that, even though it would cost the nation more money to do it, British civil aviation must take its proper place in world affairs. Unfortunately, the people who had tried, and indeed with considerable success, to carry out the original policy, were made scapegoats, and others substituted who have not yet had the opportunity to show whether they are better or worse.

### Clearly Defined Objective

In framing future policy we must first of all be quite sure of what we want to do, and of how much we are prepared to pay for it, and thereafter stick to that policy.

The present Government has made a half-hearted attempt to outline the future of civil aviation and has set up an inter-departmental committee to make certain recommendations. This is not the kind of body which is fitted to make decisions on matters of policy, and it is unfair to saddle it with the responsibility. These decisions call for a more authoritative body such as a Royal Commission and, when they have indicated the broad outlines, the picture can easily be filled in by the Under-Secretary of State, the Department, British Overseas Airways Corporation, and the others whose business it is to translate policy into action. Only by focusing on a clearly defined objective can efficient team-work be ensured.

## DECENTRALISATION

THE centre pages of this journal, which for some years have been occupied by advertisements of the de Havilland Aircraft Co., Ltd., will be used for editorial purposes henceforth and that company's advertisements will occupy smaller spaces. In explanation, the de Havilland Aircraft Company state that until the paper shortage developed they were glad to advertise to keep their name alive in those markets, especially overseas, which war conditions prevented them from serving. This company in particular has built up its business since 1920 in the hard field of civil and commercial aviation. As manufacturers and exporters of aircraft, engines and controllable-

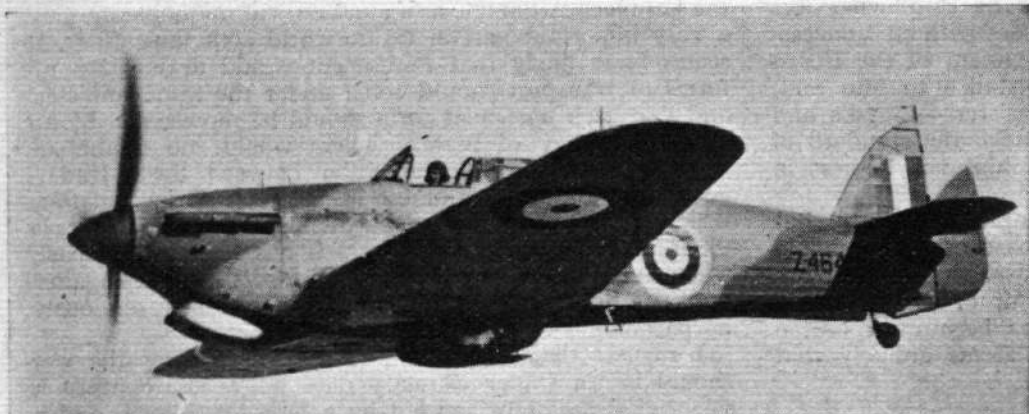
pitch airscrews, with a chain of associated companies and some large factories in the Dominions as well as flying schools and technical training establishments, they are virtually several organisations in one.

The directors have expressed their keen regret that a reduction in advertising must mean withdrawing necessary revenue from just those journals whose world-wide circulation and editorial integrity have aided enormously in the building up of de Havilland business overseas, especially as in wartime they are doing valuable work in the Services and elsewhere, particularly in the Dominions and America.

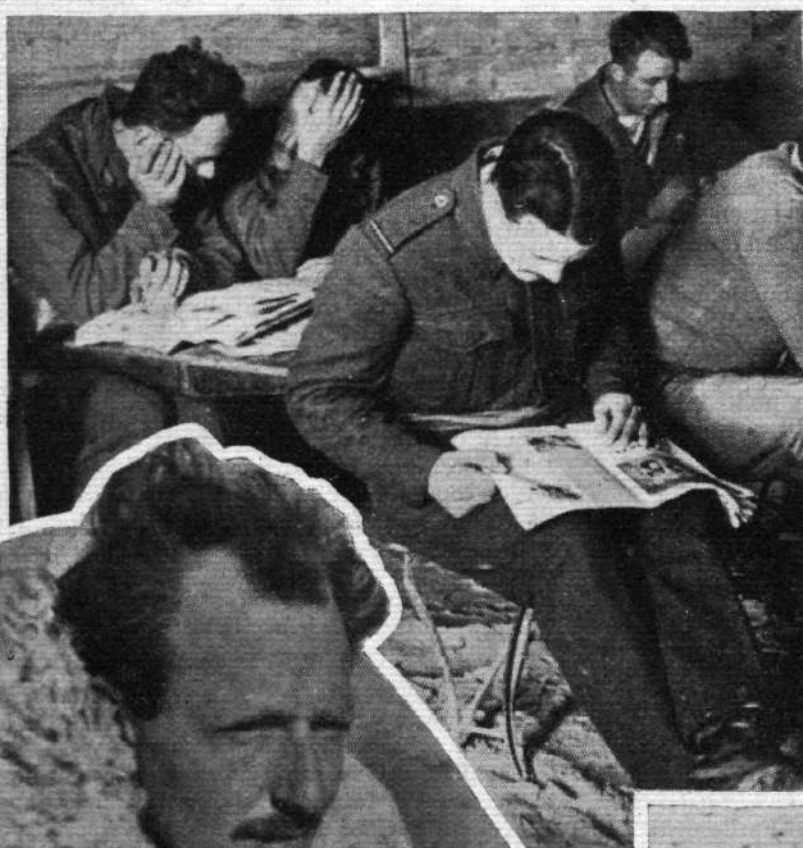


# ARMY CO-OPERATION IN

*A Photographic Survey  
of the Flying, Living and  
Working Conditions of  
a Hurricane Squadron  
Giving the Eighth Army  
Close Support*



1



2

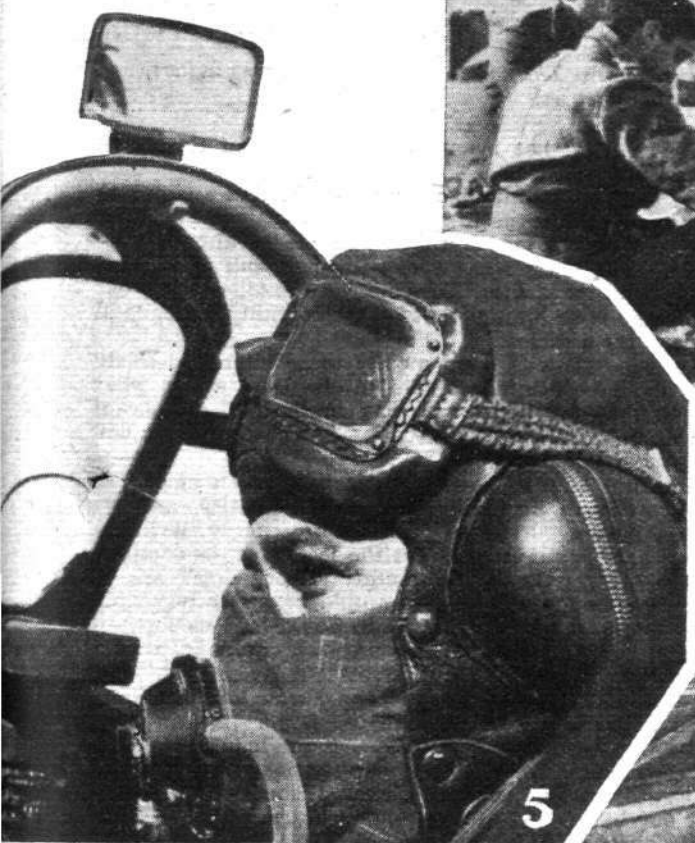


3



4

## LIBYA



(1) A Hurricane off for an artillery shoot. Note the special air cleaner intake. (2) "Comfort" in the officers' mess. (3) A sheepskin to keep out bitter winds. (4) If one is clever one can be clean. (5) Pilot wearing the combined microphone and oxygen mask which is standard in the R.A.F. (6) A fire for warmth in a desert which the popular mind thinks is always scorched. (7) The army liaison officer discusses operations with the pilots. (8) The radio ground station talking to the air.





# Correspondence

*The Editor does not hold himself responsible for the views expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters.*

## ASTRONAUTICAL RESEARCH

### British Groups Co-operating

WITH reference to Mr. R. C. Abel's letter published in *Flight* on March 19th I would like to point out that of late much has been accomplished to achieve maximum co-operation among the British rocket groups.

A committee has been formed, comprising representatives of the British Interplanetary Society (acting in an unofficial capacity, as officially the B.I.S. is inactive for the duration), the Manchester Astronautical Association, and the Astronautical Development Society. The main work of this committee is to lay a "concrete" foundation for joint post-war research, with co-operation uppermost in consideration.

At the present time research is still continuing, although naturally on a greatly diminished scale, the M.A.A. being mainly concerned with the design of a high-altitude sounding rocket, while the A.D.S. are concentrating efforts on the design of a strato-plane for trans-oceanic communication.

The address of M.A.A. headquarters, quoted by Mr. Abel as 683, Ashton New Road, Manchester, 11, is now 2, Hillview Road, Denton, Manchester, that of A.D.S. being 17, Southcote Avenue, Tolworth, Surrey.

K. W. GARTAND.  
(Secretary, A.D.S.)

## THE TANK BUSTER

### Forces in Action During Firing

IN reply to your correspondent E. D. Graham, the ability of a shell to rise to a height or pierce armour does not depend on its *momentum* = *mass* × *velocity*, but on its *energy* = *mass* × *velocity*<sup>2</sup> ×  $\frac{1}{2}$ . This he can easily check from any text-book on mechanics, but I shall try to explain the difference.

During the time of firing, equal and opposite forces act at the same time on both shell and gun, so that the factors *force* × *time* = *momentum* are the same for both, but the factors *force* × *shift* = *energy* are as dissimilar as the simultaneous movements of the shell and the barrel.

The *force* acting on a mass may be gauged by the resulting velocity after a known time, i.e.,  $\frac{mv}{t}$ , while the corresponding distance *shifted* depends on the average velocity and time, i.e.,  $\frac{v}{2} \times t$ , so that the work done or energy imparted =  $\frac{mv}{t} \times \frac{v}{2} \times t = \frac{mv^2}{2}$  as stated above.

The resistance and thickness of armour are the obvious counterparts of the firing force and length of barrel, and the link between the two is the energy of the shell in transit. The barrel continues to recoil against its spring relatively long after the shell has left it.

Therefore, the factors *force* × *time* = *momentum* may be changed by the recoil, but not so the product, and the alternative factors *mass* × *velocity* = *momentum* may be those proper to the barrel or to the whole carrying aircraft, but the product is constant.

Recently published information seems to show that heavy calibres are bearable with lines of fire fixed close to the C. of G. of fast aircraft, but it would be interesting to hear about the pitching effect of a "burst" fired from a tail turret or a flying-boat nose turret.

R. C. ABEL.

## ANXIOUS TO LEARN

### Girl Aircraft Fitters Ask for the Chance

I WAS one of the first girls in London to train as a fitter under a Government training scheme, and now I am working, with about 20 other girls, as a detail fitter for a well-known aircraft firm.

What we all desperately want to know is—how can we learn more? Are we doomed to work for the rest of the war at routine sawing and filing jobs? I asked our charge-hand how we could learn more about our jobs, and he replied, somewhat vaguely, that we would learn in time. This is all very well, but the amount we learn in the shop can be judged by the fact that I found that one of the girls, who had been there

for over a year, did not even know the name of the metal she handled daily!

We are young, alert, intelligent girls, eager and anxious to work and learn and be useful. How can we learn? There are no night-classes to teach us the science of aircraft production; we don't know what books to read, and though we study papers and magazines, like your very excellent one, our basic knowledge is so limited that we cannot fully understand or appreciate the articles.

The men we work with seem mostly to be interested solely in making money—they don't care in the least about what part the job they are doing will play in the performance of the finished aircraft; they only care whether or not it will earn them more bonus.

I, for instance, am 21 years old, gained seven credits in my school certificate, including one in mathematics, and am filled with a burning desire to place all my energy, not only my mechanical physical strength, at the service of the country.

I and the other girls at the aircraft factory don't ask to be given easy jobs for nothing—we would be perfectly willing to give up our evenings to study if it would lead us forward to intelligent jobs; jobs which perhaps we could keep after the war, and to which we could devote our lives. Can't the "stick-in-the-rut" jobs be left to people who like ruts (and there seem to be plenty of them in the factory). Can't our energies be directed to something our brains can get a grip on? All day long we do the same routine jobs—I know someone has to do them, and we stick to them for that reason, but can't our brains have something to do as well?

Even if you could tell us the name of a good book on aircraft production we would be quite immensely grateful; if you could tell us whether there would be likely to be any jobs for girls in aircraft factories after the war, and how we could learn and work to get such a job, there would simply not be words in which we could adequately express our thanks.

"BRAINS RUST."

## BOMBER ARMAMENT

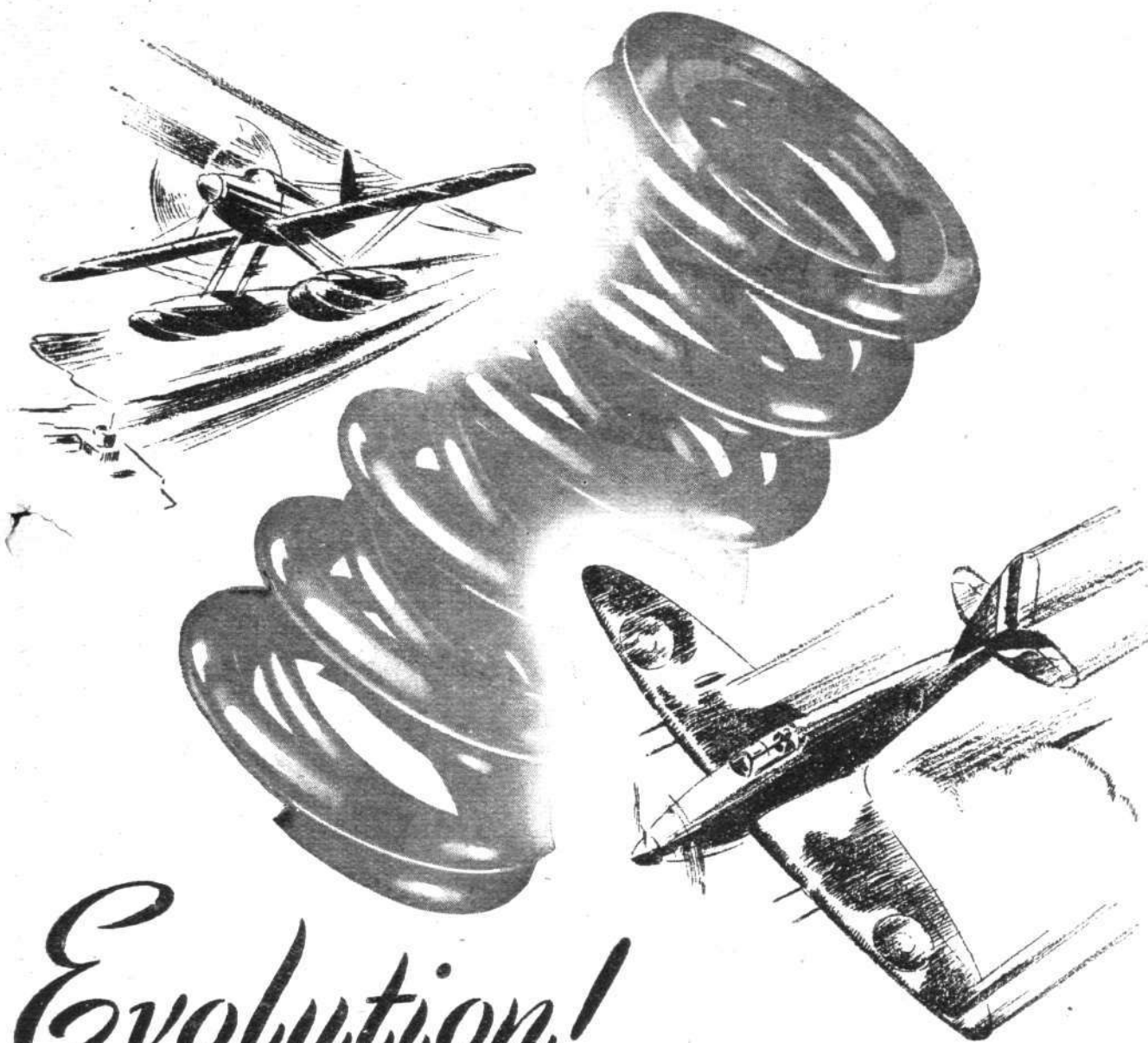
### Advantages of the Cannon Turret

IT has been a mystery to me for some time why the movable cannon has not been made more use of and developed further. The fixed cannon, as armament, has been developed a great deal in the past few years and has now become practically standard, but the movable cannon has not been heard of since the Vickers-Armstrong 33 mm. quick-firing gun was fitted to one of the Short flying boats in 1936 (I believe that is the correct year) for experimental purposes—that is, with the exception of the Dornier Do26K, which has a cannon turret in the nose.

I can see no reason why cannon should not be introduced into the movable armament of some of our heavy bombers. I do not pretend to be acquainted with the technical details of the question, but, surely, if four machine-guns can be fitted in a turret, why should not a single or twin-cannon arrangement be used instead?

With practically every modern fighter armed with cannon the bomber is not able to hit back until it has been under the fighter's cannon-fire for some seconds, the range of the cannon being so much greater than that of the machine-gun, and so the bomber is at a serious disadvantage. One of the objections often given to the use of the movable cannon is that the recoil would shake the fittings so much that it could not be brought to bear accurately on a target, but the difficulty could easily be overcome by the use of slightly stronger fastenings. These would not need to be much heavier than those used in the modern machine-gun turret. Also, would not a single movable heavy-calibre cannon be more efficient than a fixed cannon of the same type as a tank-buster? Since the movable cannon could be swung round, it could be brought to bear on the target for a longer period than the fixed cannon. From all the facts which I have stated it can easily be seen that not enough use of the movable cannon has been made in our war-planes, and I hope this deficiency will soon be remedied.

B. T. HOWARD.



# Evolution!

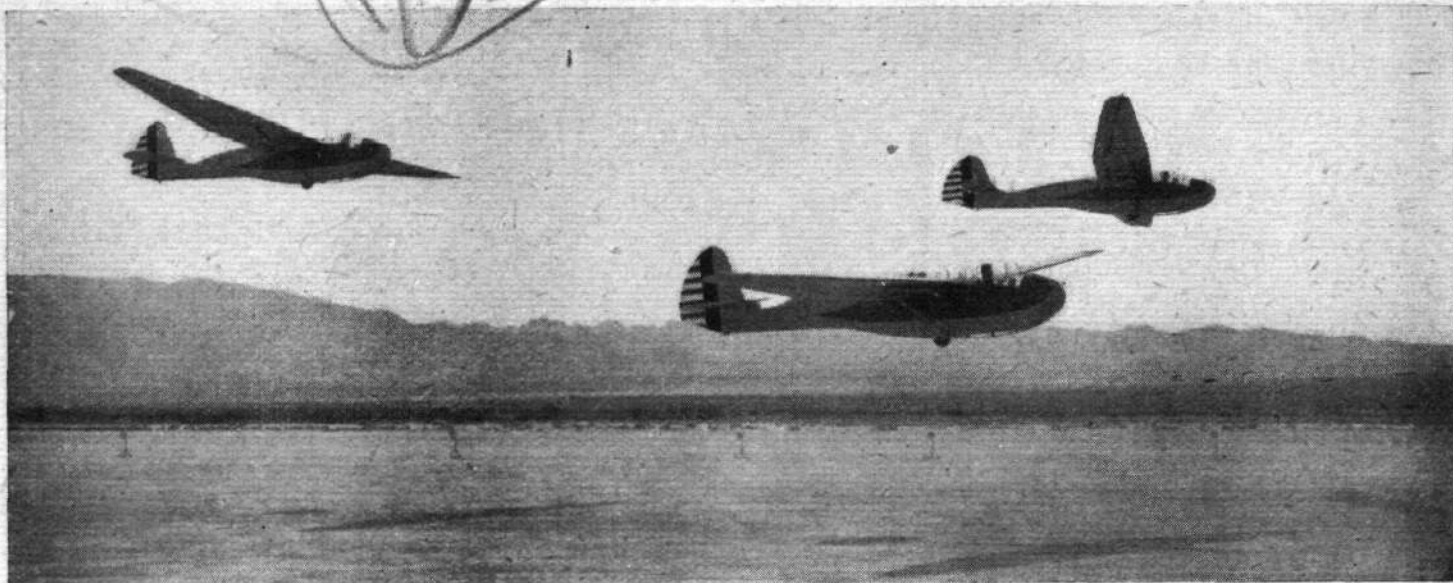
The intense speed-up in the evolution of the modern power unit is the most world-shaking event in all history. It has set the dizzy pace of war, yet holds within itself infinite possibilities for the future of mankind. It is a striking thought that behind every stage of this mechanical progress an essential factor is the power of THE SPRING. Now we, at Terry's, specialise in Springs. We make them for every purpose. Our accumulated experience and skill in pre-war days is now being used to good account, just as the experience of war-time techniques will, in turn, be at the disposal of engineers when the clouds have rolled away.

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FOR SPRINGS  
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United States Army Air Corps takes to gliding. Aircraft towing is used for launching three gliders at a time.

#### DISTINGUISHED FLYING MEDAL.

Flt. Sgt. J. W. CREEDON, R.C.A.F., No. 407 (R.C.A.F.) Sqn.

Sgt. H. C. EVERETT, No. 407 (R.C.A.F.) Sqn.

Sgt. G. HANCOX, No. 407 (R.C.A.F.) Sqn.

Flt. Sgt. Creedon, Sgt. Hancox, and Sgt. Everett were members of the crew of a Hudson which made a daring low-level attack on an enemy destroyer escorting the battleships.

Flt. Sgt. Creedon, the pilot, descended through cloud at 400 feet and sighted the German destroyer directly below. Diving through fierce flak to 200 feet, he released his bombs, which straddled the enemy warship.

As he turned away to climb back into the cloud the Hudson was attacked by a Ju.88. Sgt. Everett, rear gunner, opened fire with his turret guns, and the enemy aircraft broke off the engagement.

**THE KING** has been graciously pleased to approve the following awards in recognition of gallantry displayed in flying operations against the enemy:—

#### DISTINGUISHED SERVICE ORDER.

Flt. Lt. A. WARBURTON, D.F.C. and Bar.—This officer has carried out many missions each of which has demanded the highest degree of courage

and skill. On one occasion, whilst carrying out a reconnaissance of Taranto, Flt. Lt. Warburton made two attempts to penetrate the harbour, although as there was much low cloud this entailed flying at a height of 50 feet over an enemy battleship. In spite of the failure of his port engine and repeated attacks from enemy aircraft he completed his mission and made a safe return.

On another occasion he obtained photographs of Tripoli, in spite of enemy fighter patrols over the harbour.

In March, 1942, Flt. Lt. Warburton carried out a reconnaissance of Palermo, and obtained photographs revealing the damage caused by our attacks. This officer has never failed to obtain photographs from a very low altitude, regardless of enemy opposition. His work has been most valuable and he has displayed great skill and tenacity.

Act. Sqn. Ldr. N. J. MOWAT, No. 607 Sqn.—Since the outbreak of war, Sqn. Ldr. Mowat has completed 150 defensive patrols and 30 fighter operations over enemy territory; eight of the latter missions were carried out during the evacuation from Dunkirk when he damaged two Messerschmitt 109's. One day in June, 1940, this officer led a section of three aircraft which attacked the air-drome at Rouen Boos and damaged at least 20 enemy aircraft. More recently, Sqn. Ldr. Mowat has led successful attacks on power stations, air-dromes and barge concentrations in enemy occupied territory. In addition, several enemy anti-aircraft posts have been put out of action.

Sqn. Ldr. Mowat has also taken part in attacks against enemy shipping, during which five enemy vessels have been damaged. On the 12th February, 1942, during operations against the German battleships and their escorts, Sqn. Ldr. Mowat, in the face of fierce enemy opposition, was personally responsible for the destruction of a vessel in the convoy. This officer has consistently displayed leadership of the highest order, and his determination and complete disregard of personal danger have been an inspiration to his squadron.

Act. Wing Cdr. C. B. B. WALLIS.—After participating in the campaign in the Western Desert, Wing Cdr. Wallis took his squadron to Burma and immediately went into action. In all the important operations carried out by the squadron in Burma his qualities of leadership have done much to maintain its high morale. On several occasions Wing Cdr. Wallis's aircraft has been severely damaged by enemy anti-aircraft fire.

#### SECOND BAR TO THE DISTINGUISHED FLYING CROSS.

Act. Wing Cdr. F. R. CAREY, D.F.C., D.F.M.—When leading the squadron or wing this officer has displayed high qualities of leadership, and has set a high example by his courage and devotion to duty.

#### DISTINGUISHED FLYING CROSS.

Act. Sqn. Ldr. P. R. A. FORD.—This officer has carried out a large number of operational flights against the enemy, including successful attacks on Bangkok. Sqn. Ldr. Ford has displayed fine quali-

ties of leadership, and has consistently shown great keenness and devotion to duty.

Act. Sqn. Ldr. W. A. SMITH, No. 229 Sqn.—One day in January, 1942, Sqn. Ldr. Smith was leading the squadron whilst it was operating as escort to a formation of bombers in the El Agheila area when an attack was made by enemy fighters in greatly superior numbers. Displaying great skill, Sqn. Ldr. Smith led his formation against the enemy fighters repeatedly, but always returned to the bombers before they could be attacked by other enemy aircraft. He was himself eventually shot down whilst engaging an enemy fighter, but as a result of his courage and qualities of leadership all the bombers returned safely. Sqn. Ldr. Smith has been engaged on operations since the beginning of the war, and has completed several hundred operational flying hours. He has destroyed six enemy aircraft and probably destroyed and damaged a further seven.

P/O. N. F. DUKE, R.A.F.V.A., No. 112 Sqn.—One day in February, 1942, P/O. Duke was the leader of a section of a wing when he sighted 35 enemy aircraft. He informed the wing leader and led his section to attack. In the ensuing combat 11 enemy fighters were destroyed by the squadron, two being destroyed by P/O. Duke. This officer's leadership materially contributed to the success achieved. He has destroyed eight enemy aircraft and probably destroyed and damaged a further six.

ACT. FLT. LT. D. E. STREET, R.A.F.V.R., No. 61 Sqn.—This officer has carried out numerous sorties as captain of aircraft. By his thoroughness in preparation for his flights, combined with determination and vigour in pressing home his attacks, Flt. Lt. Street has set an outstanding example. He has carried out successful attacks against targets in Gelsenkirchen, Brest, Cologne, Hamburg, Aachen, Kiel and many other important objectives. His gallantry and devotion to duty have been worthy of high praise.

F/O. P. C. BIRCH, R.A.F.V.R., No. 20 Sqn.—In August, 1941, this officer was the pilot and captain of an aircraft detailed to attack Cologne. During the flight his aircraft was held by enemy searchlights and heavily shelled. It was then subjected to an attack by an enemy fighter which was skilfully evaded. F/O. Birch flew on towards his target but, some ten minutes later, the enemy fighter returned to the attack and inflicted severe damage to the aircraft which went into an uncontrollable dive.

Orders to stand-by to abandon aircraft were given, but F/O. Birch regained control at between 2,000-3,000 feet. The aircraft vibrated badly, but F/O. Birch decided to attempt the return flight to this country and, displaying a high standard of airmanship and determination, eventually reached base and made a safe landing.

On another occasion when returning from Dusseldorf, he descended to a low altitude and machine-gunned targets of military importance, including a train. This officer has always displayed great determination and keenness.

F/O. G. J. A. LEWIS, R.A.F.V.R., No. 61 Sqn.—In the role of rear gunner this officer has taken part in numerous sorties of a determined character. On one occasion in the Berlin area, his pilot descended to a low altitude and F/O. Lewis assisted another in silencing three anti-aircraft posts by machine gun fire. On another occasion, he machine-gunned trains from only 300 feet. He has consistently displayed great keenness, courage and devotion to duty.

F/O. I. C. K. SWALES, D.F.M., No. 15 Sqn.—This officer has carried out many sorties involving attacks against the majority of important and highly defended targets in Germany and in occupied territory. In November, 1941, he participated in a raid on Berlin and, despite intense opposition, he coolly carried out a successful bombing attack. This officer has always shown courage and determination in the face of the enemy.

F/O. A. de Q. WALKER, R.A.F.V.R., No. 49 Sqn.—The majority of the flights undertaken by this officer have been in the role of captain,



He can release eight tons of bombs at once. The bomb aimer of a Short Stirling at action station.

*continues*



## SERVICE AVIATION

but he has also acted as navigator. F/O. Walker has participated in attacks on a variety of targets, including Hamburg, Bremen, Cologne and Frankfurt. He has invariably pressed home his attacks at a low altitude. This officer has, on many occasions, made a number of runs over heavily defended targets to ensure positive identification.

In December, 1941, F/O. Walker carried out a successful daylight attack near Wilhelmshaven, damaging a railway station, a factory and destroying a section of railway track. His enthusiasm for operational flying combined with great devotion to duty have set an inspiring example.

F/O. S. le V. WOOD, R.A.F.V.R., No. 49 Sqn.—This officer has participated in numerous sorties in which a wide variety of targets have been attacked, including Bremen, Kiel, Cologne, Frankfurt and Brest. On some of these missions, F/O. Wood acted as navigator and on others as captain. Throughout, his work has been characterised by skill, courage and determination. He has frequently spent long periods in heavily defended areas in order to ensure positive identification of his objectives. He has always displayed great devotion to duty.

Act. F/O. H. T. LEGGE, R.C.A.F., No. 12 Sqn.—This officer has been employed as navigator on numerous difficult and long-range sorties over heavily defended targets. Throughout, his skill and persistence have been of a high order. On one occasion he navigated his aircraft, which had only one engine functioning, from Nurnberg to this country through extremely hazardous weather conditions and in the face of almost continuous enemy opposition. His exceptional ability was mainly responsible for the safe return of the aircraft. It is believed that this single-engine emergency flight of a Wellington aircraft is the longest on record. F/O. Legge is a most determined and skilful air observer.

Act. F/O. D. S. S. WILKERSON, R.A.F.V.R., No. 35 Sqn.—As a pilot and captain of aircraft, this officer has shown outstanding ability and keenness and he has succeeded in reaching and bombing his objectives with unfailing regularity and success. F/O. Wilkerson has attacked a wide range of enemy targets, including Berlin, Nuremberg, Kiel and Essen, besides other industrial centres and dockyard towns. He took part in two daylight raids on the enemy warships at Brest, and in spite of fierce opposition carried out his attacks with the utmost skill and determination. F/O. Wilkerson has proved himself to be a courageous captain.

P/O. P. F. ALLEN, R.A.F.V.R., No. 101 Sqn.—This officer has proved himself to be a most capable and determined captain of aircraft. His numerous night sorties include attacks on Berlin, Hanover and Turin, while his daylight bombing of ships, at low level, proved very successful.

P/O. C. A. BARNES, R.A.F.V.R., No. 12 Sqn.—This officer has carried out sorties over heavily defended targets, including Berlin, Stettin, Wilhelmshaven, Hamburg and Cherbourg. His attacks have been carried through with skill and determination and on numerous occasions he has remained in heavy defence concentrations while making several runs over the target. He is a fine operational pilot and captain of aircraft.

P/O. R. G. DALE, R.C.A.F., No. 150 Sqn.—This officer joined the squadron as a sergeant, and has since participated in sorties over Germany and the occupied countries. His ability as a navigator, outstanding, and, combined with his great determination to achieve success, he has inspired the utmost confidence in his crew. On many occasions he has navigated his aircraft in extremely adverse weather, and his co-operation and coolness have been largely responsible for the safe return of the aircraft. P/O. Dale has displayed high courage and devotion to duty.

P/O. I. M. DAVIES, No. 82 Sqn.—This officer has participated in many operational sorties by day as wireless operator-air gunner. A high proportion of these flights have been low level attacks on shipping off the coast of Norway and in the Mediterranean. On one occasion he resisted five Messerschmitt 110s for 15 to 20 minutes, shooting one down in flames. On another occasion he drove off two Messerschmitt 109s after a 23-minute engagement. Throughout P/O. Davies has shown the greatest keenness to engage the enemy. By his courage and unfailing enthusiasm he has set an excellent example.

P/O. C. J. FOOKS, R.A.F.V.R., No. 101 Sqn.—This officer has participated in numerous sorties, including attacks on Berlin, Stettin, Rotterdam, Brest and important industrial targets in Germany. On two occasions his aircraft has been attacked by night fighters, one of which was shot down by his rear gunner after the aircraft had sustained damage.

During an attack against Wilhelmshaven, the port engine of P/O. Fooks's aircraft developed trouble, the oil pressure being zero and engine revolutions not registering. Nevertheless, he coolly and skilfully flew back to this country, and though the defective engine stopped completely during the landing run, he made a perfect landing. Throughout this officer has shown excellent leadership and skill and he has won the entire confidence of his crew.

P/O. A. C. GEARY, R.A.F.V.R., No. 211 Sqn. (Deceased.) Awarded with effect from March 21st, 1941.—This officer has completed many sorties, of which 38 were carried out within 42 days. He has acted as rear gunner in his commanding officer's aircraft for six months, and his keen observation and clear reports on the manoeuvres of enemy aircraft have undoubtedly helped to save our own aircraft on many occasions. He has assisted in beating off enemy fighters on 16 occasions.

His courage and devotion to duty have been exemplary.

P/O. R. L. G. HOSEA, R.C.A.F., No. 115 Sqn.—Throughout the many sorties in which he has participated, this officer has displayed exceptional navigational ability combined with great determination not only to bomb his objective, but to obtain photographs of the results. On several occasions during the winter months, when navigation was rendered extremely difficult owing to bad weather, P/O. Hosea never failed to navigate his aircraft back to base without difficulty. He has participated in attacks against a wide variety of enemy targets, including raids on Berlin, Stettin, Brest, Kiel and Wilhelmshaven. His skill and tenacity have been outstanding.

P/O. A. H. METCALFE, R.A.F.V.R., No. 455 (R.A.A.F.) Sqn.—This officer has proved himself to be one of the most outstanding captains of this Australian squadron. He has carried out his operational tasks with efficiency and a resolute determination to achieve success.

P/O. Metcalfe has participated in raids on Bremen, Hamburg, Cologne, Cherbourg, and many other enemy targets. On three occasions he has taken part in sorties for which the squadron received congratulatory messages from the command.

P/O. P. J. OLEINEK, R.C.A.F., No. 12 Sqn.—This officer has completed numerous sorties over enemy and enemy-occupied territory. He is a skilful and determined captain of aircraft, who, by his excellent example and high morale, has won the entire confidence of his crew. On one occasion, when subjected to intense enemy fire over Stettin, his aircraft was forced down to a height of only 50 feet. His aircraft sustained damage, but, in spite of this, he coolly and skilfully flew at this height over highly defended areas and eventually reached this country. P/O. Oleinek has displayed fine powers of leadership.

P/O. V. W. PARRY, R.A.F.V.R., No. 150 Sqn.—This officer, who joined the squadron as an N.C.O., has completed numerous sorties as rear gunner over Germany, Italy and the occupied countries. As flight gunnery leader he has displayed exceptional skill and determination in action. Fearless in the face of danger, he has set an example which has proved a source of inspiration to his fellow-gunnery.

P/O. R. P. RUNAGALL, R.A.F.V.R., No. 115 Sqn.—This officer has carried out numerous sorties, on over half of which he has acted as captain of aircraft. Attacks have been carried out on most of the important enemy targets, including Brest, Berlin, Munster, Stettin and Kiel. P/O. Runagall has always shown the greatest determination to locate and bomb his objective, and, although he has often flown in extremely unfavourable conditions, he has not once failed to reach the target. His aircraft has suffered damage on several occasions. Throughout, P/O. Runagall has shown ex-



The Polish army co-operation squadron of the R.A.F. has attained great proficiency. The picture shows the camera being removed from a Lysander.

cellent leadership, and he has displayed great devotion to duty.

P/O. J. A. V. STOCKLEY, R.A.F.V.R., No. 217 Sqn. (deceased).—Awarded with effect from August 15th, 1941. This officer has proved an exceptional air observer. He has participated in attacks both on the enemy's shipping and aircraft. His skill and coolness are only matched by the courage and initiative of his captain, their combination resulting in excellent team work, which has contributed largely to the successes achieved. P/O. Stockley has secured excellent photographs during action.

P/O. R. F. L. TONG, R.A.F.V.R., No. 57 Sqn.—Since July, 1941, this officer has participated in numerous sorties, and he has acted as captain of aircraft on most of them. Undeterred by adverse weather conditions or enemy opposition, P/O. Tong has displayed great determination in pressing home his attacks, often from a low altitude. In September, 1941, he bombed an objective in Berlin in the face of extremely heavy defensive fire. P/O. Tong flew safely back to this country and made a successful landing in appalling weather conditions. He has been most painstaking in the training of his crew, and he has set an inspiring example.

P/O. K. D. WHISKEN, R.A.F.V.R., No. 102 Sqn.—This officer has participated in sorties both as second pilot and as captain of aircraft. He has shown exceptional skill and determination in pressing home his attacks at all times. P/O. Whisken has attacked many important targets in Germany, including Hamburg, Mannheim, Frankfurt, Stettin and Cologne. He has at all times set a courageous example.

Act. Sqn. Ldr. F. C. C. TOMKINS, No. 37 Sqn.—One night in March, 1942, Sqn. Ldr. Tomkins, as senior captain of aircraft, participated in a successful attack on Palermo. He spent a considerable time over the harbour, in the face of intense anti-aircraft fire, before making his attack. He suc-



Air cadets at America's "International Squadron" in Arizona. Countries represented in this picture are China, Great Britain, America and Cuba.



## SERVICE AVIATION

ceeded in setting a large enemy merchant vessel on fire, thereby assisting other aircraft in locating the target area in subsequent attacks.

As a result of the operation, two enemy vessels of 6,000 tons were sunk and one 9,000-ton vessel was severely damaged. Considerable damage was also caused to harbour installations. The successes achieved were largely due to *Sqn. Ldr. Tomkins'* courage and determination.

## DISTINGUISHED FLYING MEDAL

*Sgt. L. G. Fuller, R.A.A.F., No. 37 Sqn.*—One night in March, 1942, this airman was captain of an aircraft which participated in an attack on Palermo, when two enemy vessels of 6,000 tons were sunk, another severely damaged, and much destruction caused to harbour installations. Having set one of the enemy vessels on fire, this airman flew back to his base for his aircraft to be refuelled and rearmed. He then returned to the target and after making a second attack on the ships, remained over the area for some time in order to prevent fire fighting parties from working.

*A/C.1 R. D. K. Hadden*—This airman has accompanied *Flt. Lt. Warburton* on all his operational flights and has displayed great keenness and devotion to duty. On numerous occasions when his aircraft has been attacked by enemy fighters, *A/C. Hadden* has given valuable assistance to his pilot by informing him of the position and movements of the attacking aircraft. On all occasions this airman has shown great coolness in the face of the enemy and has thus done much to ensure their safe return. He has set an excellent example to all.

*Flt. Sgt. H. L. Gill, R.C.A.F., No. 607 Sqn.*—Since joining the squadron, this airman has carried out several offensive fighter patrols over enemy territory, both by day and by night. Targets attacked include power stations, barge concentrations, and factories. On one occasion *Flt. Sgt. Gill* sighted two of our aircraft which had been forced down on to the sea and remained over them alone until driven off by a formation of enemy fighters.

On the 12th February, 1942, this airman participated in operations against the German battleships and their escort and pressed home his attacks with great determination in the face of fierce enemy opposition. He damaged at least one enemy motor vessel and one enemy aircraft. This airman has always displayed initiative and keenness and has proved himself to be an inspiration to his fellow pilots.

*Sgt. R. M. Leu, R.A.A.F., No. 112 Sqn.*—One day in January, 1942, *Sgt. Leu* was flying at the rear of his formation, which was operating as close escort to a squadron of bombers, when an attack was made by a formation of German fighters. In an engagement lasting over 20 minutes, this airman repeatedly engaged the enemy, destroying one of their aircraft and probably destroying another. The enemy was finally beaten off. *Sgt. Leu* has led the squadron and wing on many occasions and has displayed outstanding courage and ability. He has destroyed at least seven enemy aircraft.

*Sgt. W. A. Mailey, R.A.A.F., No. 3 (R.A.A.F.) Sqn.*—One day in February, 1942, *Sgt. Mailey*, whilst leading the squadron, sighted six Messerschmitt 109's which were preparing to attack from above. The enemy aircraft were engaged and as a result five of them were destroyed and the sixth damaged. *Sergeant Mailey* then led his squadron in an attack on other enemy aircraft below. Under his sound leadership, the squadron destroyed four of these, making a total of nine, two being shot down by *Sgt. Mailey*. This airman has completed many operational sorties and has destroyed six enemy aircraft and damaged five others.

## GEORGE MEDAL

*Sgt. M. A. Sullivan, R.A.A.F. (now missing).*—In November, 1941, an aircraft crashed and burst into flames, *Sgt. Sullivan*, the rear gunner, got out of his turret. Finding no other member of the crew clear of the crash, he clambered along the blazing wing and despite having burnt his hand, continued into the fuselage to rescue other members of the crew.

With the assistance of two soldiers who had since arrived on the scene, he was able to remove to safety a member of the crew who had a broken leg. He returned to the crash and again entering the fuselage succeeded, with the assistance of one of the soldiers, in removing another member of the crew who also had a broken leg.

Despite the growing intensity of the fire he entered the fuselage for the third time to make sure that no other member of the crew was present. He noticed through the tangled wreckage that one of the soldiers was working frantically to extricate the navigator who had been trapped in the forward part of the aircraft. He therefore ran round to assist him and together they succeeded in removing the navigator who had serious head injuries.

He then helped the two soldiers to remove the remaining three members of the crew.

## Roll of Honour

Casualty Communique No. 122.

THE Air Ministry regrets to announce the following casualties on various dates. The next-of-kin have been informed. Casualties reported "in action" are due to flying operations against the enemy; "on active service" includes ground casualties due to enemy action, non-operational flying casualties, fatal accidents and natural deaths.

## Royal Air Force

**KILLED IN ACTION.**—*Sgt. G. A. Anson*; *Sgt. W. E. H. L. Brown*; *Sgt. C. D. E. Campbell*; *Flt. Sgt. J. A. Dodds*; *P/O. E. M. Hooper*; *Sgt. G. H. Horobin*; *Sgt. A. L. Maslen*; *Act. Sqn. Ldr. E. M. Mason, D.F.C.*; *Sgt. F. C. R. Matson*; *Sgt. W. Powell*; *Sgt. D. T. E. Reid*; *Sgt. P. H. Roan*; *Sgt. D. V. Saunders*; *Sgt. C. G. Sewell*; *P/O. W. T. De R. Waters, D.F.C.*

**PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.**—*Sgt. D. C. Bass*; *Act. P/O. K. O. Blunden*; *Sgt. H. J. Cassar*; *P/O. E. F. Drew*; *Sgt. M. G. Garner*; *Sgt. H. T. Holme*; *Act. Wing Cdr. T. M. Hunt, D.F.C.*; *Sgt. L. M. Megginson*; *Sgt. G. Nicolson*; *Sgt. J. Taylor*; *Flt. Sgt. F. S. Thrupp*; *Sgt. K. C. Tucker*; *Sgt. J. P. Wood*; *P/O. J. D. Wright*; *Flt. Sgt. L. S. B. Younger*.

**PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.**—*Sgt. A. I. P. Anderson*; *P/O. A. C. Argent*; *Sgt. H. R. Barton*; *Sgt. C. R. Batchellor*; *Sgt. J. W. Bent*; *P/O. G. N. Bevan*; *Flt. Sgt. R. G. Brown*; *Sgt. D. G. Brown*; *Flt. Sgt. R. Collins*; *P/O. L. E. Cook*; *Sgt. J. C. Cottingham*; *P/O. B. C. Curtis*; *Sgt. P. A. Davies*; *Flt. Sgt. S. A. Elsy*; *Sgt. W. Everest*; *Sgt. A. W. D. Frost*; *Sgt. W. E. Grainger*; *Act. Flt. Lt. C. E. C. Haggitt*; *Sgt. G. M. Hardy*; *Sgt. F. A. Harmer*; *Sgt. B. E. Haycock*; *Flt. Sgt. L. Hemingway*; *Sgt. W. G. Herrod*; *Sgt. T. I. Hicks*; *Act. Flt. Lt. W. Hughes*; *Sgt. J. Hunter*; *Sgt. H. Jones*; *Sgt. R. F. Lewis*; *Sgt. H. G. Lunan*; *P/O. J. D. W. McCallum*; *Sgt. K. G. Macleay*; *Sgt. A. M. Metaxa*; *Sgt. F. L. Mollen*; *A/C.1 J. Monro*; *Sgt. A. C. Moss*; *Sgt. G. A. Munro*; *Sgt. J. Newhouse*; *Sgt. S. T. O'Mara*; *Sgt. P. Prosser*; *P/O. R. C. S. Renshaw*; *Sgt. H. J. Reynolds*; *P/O. W. G. Rowe*; *Sgt. S. Sparkes*; *Flt. Sgt. C. G. White, A.F.M.*; *Sgt. M. Wilding*; *P/O. C. C. Wilson*; *Sgt. R. F. G. Witherington*; *Sgt. J. K. Woodhams*; *Sgt. W. H. Wyatt*.

**WOUNDED OR INJURED IN ACTION.**—*Sgt. G. F. Brett*; *Sgt. B. Cain*; *Sgt. S. V. Hardman*; *Sgt. B. P. Lunn*; *P/O. J. D. P. D. Thompson*.

**PREVIOUSLY REPORTED KILLED IN ACTION, NOW REPORTED MISSING, BELIEVED KILLED IN ACTION.**—*Sgt. N. E. Cooke*; *Sgt. R. Enticknap*; *Sgt. L. Wishart*.

**MISSING, BELIEVED KILLED IN ACTION.**—*F/O. P. A. Annan*; *Sgt. L. W. Jaggard*; *Sgt. H. Mayor*; *P/O. H. J. Parker*; *Sgt. W. Rutherford*.

**MISSING.**—*Sgt. A. F. Boucher*; *Sgt. L. N. Brown*; *Flt. Sgt. A. H. Brunt*; *F/O. D. G. Carter*; *Sgt. R. J. Cridge*; *P/O. T. McE. Dando*; *Sgt. R. B. Dick*; *Sgt. T. K. Downes*; *Flt. Lt. A. J. H. Finch, D.F.C.*; *Sgt. D. Y. Fyfe*; *Sgt. I. S. Greenstreet*; *Sgt. F. G. Hancock*; *Act. Sqn. Ldr. G. L. B. Harris*; *Sgt. P. W. Hine*; *Sgt. B. Hunter*; *W/O. W. J. Jewell*; *Sgt. J. J. Knight*; *Sgt. C. Lee*; *Sgt. D. N. MacNab*; *Sgt. T. McNeill*; *P/O. G. W. Martin*; *Sgt. D. W. Meeking*; *Sgt. A. W. E. Nelson*; *Flt. Sgt. D. C. Pollitt*; *Sgt. D. G. F. Poxon*; *Sgt. P. V. E. Rothery*; *Sgt. H. Rowsell*; *Sgt. G. D. Savage*; *Sgt. W. Smith*; *P/O. E. J. Staerck*; *Sgt. D. M. Symes*; *Flt. Sgt. E. P. Walker*; *Sgt. T. H. F. Wood*.

**MISSING, BELIEVED KILLED ON ACTIVE SERVICE.**—*Sgt. J. F. Hubbard*; *Sgt. W. J. O. Nightingale*.

**KILLED ON ACTIVE SERVICE.**—*A/C.1 J. F. Agar*; *Flt. Sgt. G. R. M. Alexander*; *Sgt. W. L. Ashplant*; *A/C.2 G. G. Baker*; *L.A/C. E. L. J. Beaumont*; *A/C.2 T. G. Beynon*; *F/O. K. S. Booth*; *F/O. G. D. Calderhead*; *Sgt. H. Clark*; *P/O. R. E. Cobb*; *P/O. D. E. C. Coleman*; *Sgt. I. H. Cunningham*; *Sgt. C. C. Davies*; *Sgt. C. R. Dickson*; *Sgt. G. N. Duke*; *Sgt. F. Dutton*; *L.A/C. K. Ellis*; *Sgt. J. H. Harker*; *Sgt. R. Hodgson*; *Sgt. R. G. Hornsby*; *Cpl. K. B. Horwood*; *Sgt. F. B. Kaye*; *Sgt. A. Livingstone*; *A/C.2 A. McKee*; *L.A/C. J. F. McKenzie*; *A/C.2 K. I. Oliver*; *L.A/C. J. H. Potts*; *Sgt. G. C. Robertson*; *L.A/C. A. A. W. Robinson*; *Flt. Lt. B. J. Rofe*; *F/O. A. H. Sanders*; *Sgt. W. E. Smith*; *L.A/C. G. W. Taylor*; *Sgt. W. Walsh*; *F/O. D. P. Watson*; *L.A/C. G. C. Wellings*; *A/C.2 J. C. Williams*; *P/O. A. S. Witter*; *L.A/C. J. D. Wood*; *A/C.2 P. Wray*.

**PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW PRESUMED KILLED ON ACTIVE SERVICE.**—*Sgt. A. R. Jones*; *Flt. Lt. W. S. Rea, D.F.C.*; *Flt. Lt. R. J. Vaughan, D.F.C.*

**PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED ON ACTIVE SERVICE.**—*Cpl. C. D. Bradbury*; *L.A/C. J. W. Clarkson*; *L.A/C. D. C. F. Evans*; *F/O. W. A. Foster*; *Cpl. D. M. Grant*; *P/O. J. G. Jones*.

**PREVIOUSLY REPORTED MISSING, BELIEVED KILLED ON ACTIVE SERVICE, NOW REPORTED KILLED ON ACTIVE SERVICE.**—*A/C.2 A. Claven*; *A/C.2 D. L. J. Evans*; *A/C.2 K. Musgrove*.

**WOUNDED OR INJURED ON**

**ACTIVE SERVICE.**—*Sgt. J. W. Edwards*; *Sgt. R. A. Henderson*; *Sgt. M. Horne*; *L.A/C. W. R. Kennel*; *Sgt. W. Martin*; *Flt. Sgt. W. F. Nurse*; *Cpl. R. Peters*; *A/C.1 J. Stott*.

**DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.**—*L.A/C. A. F. Ferris*; *A/C.2 J. Maltman*.

**DIED ON ACTIVE SERVICE.**—*A/C.1 A. G. Amer*; *L.A/C. H. W. S. Cox*; *L.A/C. E. W. Field*; *Sgt. K. Lineoln*; *A/C.2 R. P. Marriott*; *P/O. T. M. Robinson*; *A/C.2 A. A. Vaughan*; *L.A/C.2 G. E. Wicks*.

**PREVIOUSLY REPORTED MISSING, NOW REPORTED PRISONER OF WAR.**—*Sgt. C. Paterson*; *Sgt. H. Rose*; *Sgt. P. S. Simpson*; *F/O. B. R. M. Wade*.

**Amendment to Casualty Communique No. 107.** **PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.**—*For Sgt. N. H. Thomas read Flt. Sgt. N. H. Thomas*.

## Women's Auxiliary Air Force

**DIED ON ACTIVE SERVICE.**—*Act. Sgt. M. Salvage*.

## Royal Australian Air Force

**WOUNDED OR INJURED IN ACTION.**—*F/O. A. W. Batt, D.F.C.*

**KILLED ON ACTIVE SERVICE.**—*P/O. D. C. Anderson*; *Sgt. J. Bishop*; *Sgt. J. H. Goldie*; *Sgt. R. L. Tressidder*; *Sgt. J. H. Ware*.

**WOUNDED OR INJURED ON ACTIVE SERVICE.**—*Sgt. A. J. Brock*.

**DIED ON ACTIVE SERVICE.**—*Sgt. R. W. Davidson*.

## Royal Canadian Air Force

**KILLED IN ACTION.**—*Flt. Sgt. W. P. Connell*; *Sgt. E. S. Foster*; *Sgt. J. F. A. Giffin*; *Flt. Sgt. G. R. Miller*.

**PREVIOUSLY REPORTED MISSING, BELIEVED KILLED IN ACTION, NOW PRESUMED KILLED IN ACTION.**—*Sgt. W. E. Allan*; *Sgt. W. L. Berry*; *Sgt. A. J. Childs*; *Sgt. H. B. Clark*; *Sgt. J. D. Edworthy*; *Sgt. J. H. Painter*.

**PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.**—*Sgt. W. P. Grant*; *Sgt. J. L. Lockwood*.

**WOUNDED OR INJURED IN ACTION.**—*Sgt. J. L. Gaucher*.

**MISSING, BELIEVED KILLED IN ACTION.**—*Flt. Sgt. J. L. Mitchell*.

**MISSING.**—*P/O. G. K. Armstrong*; *P/O. W. F. Bond*; *P/O. J. N. Cawsey*; *P/O. G. J. Davis*; *P/O. R. A. Laing*; *Act. F/O. H. H. Miller*; *Flt. Sgt. J. W. Poirier*; *Sgt. G. H. S. Ross*.

**KILLED ON ACTIVE SERVICE.**—*Sgt. D. G. Allen*; *Sgt. G. R. Duncan*; *P/O. T. R. Godfrey*; *Flt. Sgt. J. R. Lucas*; *P/O. G. F. S. Mackie*; *Sgt. C. J. Scott*; *Sgt. W. L. Sinclair*; *P/O. W. D. Sugrue*; *Sgt. J. R. Vian*.

**DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.**—*Flt. Sgt. R. N. Langley*.

## Royal New Zealand Air Force

**KILLED IN ACTION.**—*Sgt. L. L. Bentley*; *Sgt. P. L. Elliott*; *Sgt. R. A. Kemp*.

**PREVIOUSLY REPORTED MISSING, NOW PRESUMED KILLED IN ACTION.**—*P/O. T. H. Robertson*.

**MISSING.**—*Sgt. A. H. L. Jackson*; *P/O. I. S. Stone*.

**KILLED ON ACTIVE SERVICE.**—*P/O. E. Bright*; *Sgt. H. C. George*; *Sgt. P. J. H. Hain*; *P/O. J. R. Reenberg*; *P/O. F. B. Richardson*; *C. C. Shaw*; *Sgt. V. A. Walters*; *P/O. D. G. West*.

**DIED OF WOUNDS OR INJURIES RECEIVED ON ACTIVE SERVICE.**—*L.A/C. C. M. Kayser*.



"Crikey" was the nickname given to the original Whirlwind fighter. The nose armament of four 20 mm. Hispano cannons certainly justifies the exclamatory title.

Whirlwind