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Colin Hinson
In the village of Blunham, Bedfordshire.

AIR TRAINING CORPS GAZETTE

Vol. IV No. 6 JUNE 1944 6d.

AIR TRAINING CORPS GAZETTE

PUBLISHED FOR THE AIR LEAGUE OF THE BRITISH EMPIRE, 1A, PALL MALL EAST, S.W.1 (TELEPHONE ABBEY 5041), BY THE ROLLS HOUSE PUBLISHING CO., LTD., ROLLS HOUSE, BREAMS BUILDINGS, LONDON, E.C.4.

VOL. IV NO. 6 — *Edited by Leonard Taylor* — JUNE 1944

Units and the New Training

By the Chief Commandant

DURING the recent weeks I have had the opportunity of visiting a number of squadrons in various parts of the country. Although the different squadrons vary in size and to some extent in their composition, I was both gratified and impressed with the uniformly high standard and morale.

South-East Command

One outstanding occasion was the church parade on St. George's Day, when squadrons of South-East Command, attending Divine service in St. George's Chapel, Biggin Hill, commemorated those pilots and others from this famous station who fell in action during the Battle of Britain.

Ardale and Cosford

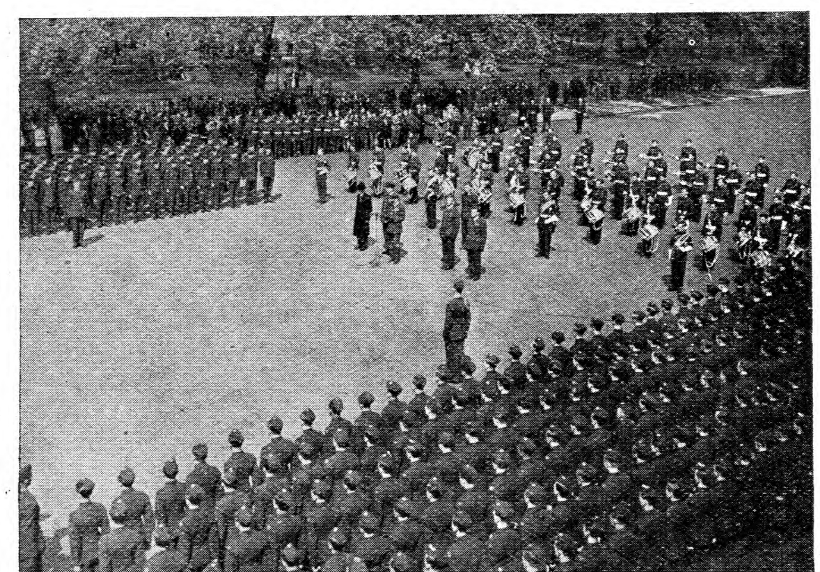
The Ardale School unit presented a very fine display of drill and P.T.; and at Cosford I saw cadet N.C.O.s going through their special courses with the R.A.F. I was able to talk to parties of N.C.O.s on the flying field, where air experience was in progress; in the navigation classroom; and at instruction at a field kitchen where the day's dinner was being cooked. I was much struck by the enthusiasm and keenness displayed in these branches of instruction—most particularly by the novelty and real value of the field cooking.

Culford, Bury and Halstead

Excellent parades were held by the Culford School (Bury St. Edmunds) unit and by the Bury St. Edmunds squadron, with which were gathered units from the surrounding country. At Halstead (Colne Valley) I was able to see first-class work going on. A fine headquarters and club at Halstead, which has brought three formerly separated flights together, is evidently a great asset in improving training and welfare generally.

No. 709 (Scarborough High School) Squadron won the Yorkshire Aircraft Recognition Championship. Here is the winning team with the cup.
(*Photograph by Yorkshire Post*)

Two V.C.s and the father of Flight Sergeant Arthur Louis Aaron, V.C., took part in a ceremony at Wellington Barracks, when Air Marshal Sir Leslie Gossage, the Chief Commandant, read the citation of Flight Sergeant Aaron's V.C.



Melton Mowbray

At Melton Mowbray I witnessed the "Battle of Melton Mowbray," one of the best examples of live and interesting training developed by an A.T.C. squadron which I have yet seen. The elements of competition and realism in training, as opposed to strictly classroom work, which are the basis of our new ideas of instruction, are strongly exemplified in this "Battle," and I recommend inquiries being addressed to Headquarters, Midland Command, by units who are interested in seeking further details.

E. L. GOSSAGE, *Air Marshal, Chief Commandant and Director General, Air Training Corps.*

Bomber Command Aims and Achievements

BY AIR MARSHAL SIR ROBERT SAUNDBY, K.B.E. C.B. M.C. D.F.C. A.F.C.

Air Marshal Sir Robert Saundby, the Deputy Chief of Bomber Command, has written this article specially for the Air Training Corps Gazette. In it he shows how Bomber Command has grown in accordance with the plans made long before the war, and tells of the effect of its blows on German production, and how they have resulted in the weakening of the German army on the Russian front and a check to the U-boat compaign.

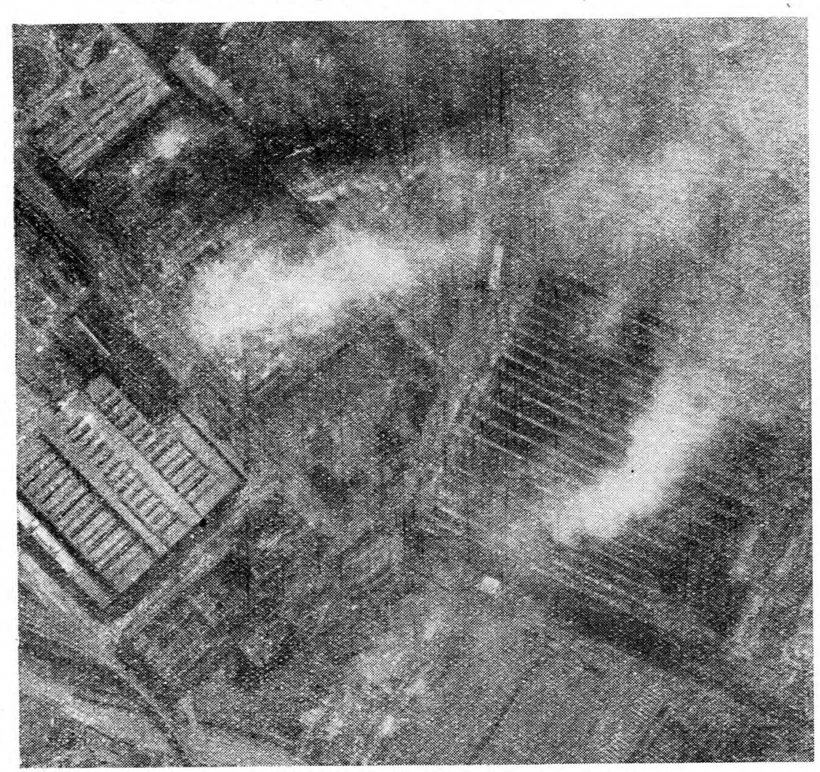
BRITAIN has had a bomber force since 1925, when what was called "The Air Defence of Great Britain came into existence. This formation contained both bombers and fighters until 1937, when it split up into Bomber and Fighter Commands. Ever since the beginning, in 1925, those who trained and directed the very small Air Force of that time had in mind that the bombers in any future war should carry out strategic bombing attacks on the enemy's war industries to prevent him from producing the weapons needed for all his armed forces. As early as 1936, three years before the beginning of this war, the Air Ministry put out the specifications for the heavy bombers of today, the Lancasters, Halifaxes and Stirlings.

Making Do

It was not until 1942, six years after the specifications for the heavy bomber were put out, that Bomber Command began to have any large force of these aircraft. At the beginning of the war the Command had only a number of light bombers, single-engined Battles and two-engined Blenheims, a very few medium bombers, Whitleys and Wellingtons, and no four-engined bombers at all. With this very small force Bomber Command carried out a number of operations which had little to do with strategic bombing as the Air Staff had conceived it before the war or as it afterwards became. The first task was the bombing of German warships in daytime; our small force of bombers had many casualties in some of these attacks, and it became obvious that if the R.A.F. were eventually to succeed in building up a large bomber force it would have to concentrate on night bombing.

The aircraft were also modified and better equipped to stand up to the German defences. Valuable practice in long-range navigation by night and flying in bad weather was gained during the "leaflet raids" of the first winter of the war, at a time when no bombing of land targets in Germany was allowed. When the Battle of France began Bomber Command had to fight hard in support of the Army, and lost many aircraft in the process. After the fall of France the bomber squadrons were seriously depleted, but their strength was energetically restored, and the Command was soon able to play its part in the Battle of Britain by bombing the ports which the Germans were planning to use for the invasion of Britain.

Krupps' works at Essen after a night raid by Bomber Command.



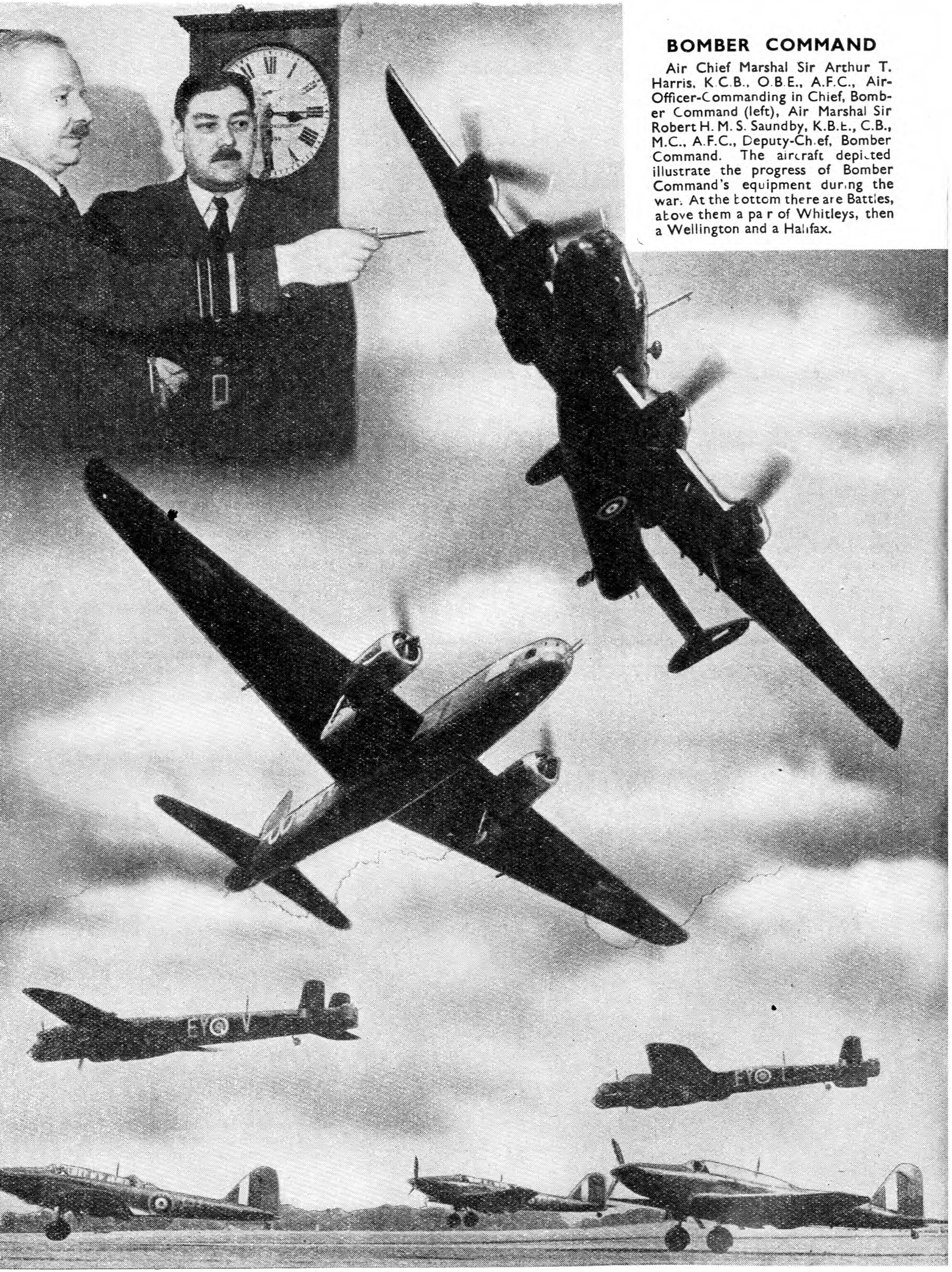
German Failure

After the Battle of Britain was won the German Air Force began the night bombing of British cities, and there was a call for such counter-measures as Bomber Command could undertake, with its still very small force, to maintain civilian morale during a critical time. In this way the Command began, on a very small scale, the strategic bombing of German industry, beginning with attacks on individual factories.

The Germans, meanwhile, were demonstrating their lack of understanding of strategic bombing in their attacks on England. After their bombers had been used to prepare the way for invasion, and had failed in this task, the Luftwaffe's attacks by night were intended to break down civilian morale, and failed in this also. The German air force had not been trained in strategic bombing by night, and their tactics were also based on mistaken ideas; their failure could not therefore be used as an argument to prove that Bomber Command would fail in its attacks on Germany.

Expansion

As the raids on this country slackened and stopped, Bomber Command began to go over to the real offensive, which has been sustained and intensified ever since. Three main problems had then to be solved before the offensive plan could properly be carried out. The problems were: to expand the Command and re-equip with better aircraft, while attacking the enemy on



BOMBER COMMAND

Air Chief Marshal Sir Arthur T. Harris, K.C.B., O.B.E., A.F.C., Air-Officer-Commanding in Chief, Bomber Command (left), Air Marshal Sir Robert H. M. S. Saundby, K.B.E., C.B., M.C., A.F.C., Deputy-Chief, Bomber Command. The aircraft depicted illustrate the progress of Bomber Command's equipment during the war. At the bottom there are Battles, above them a pair of Whitleys, then a Wellington and a Halifax.

every possible occasion; to find and hit the targets in darkness and in the very difficult circumstances with which the Command was faced; to counter the enemy's defences, which were growing in strength and efficiency.

Training

Without a sound training plan, the importance of which I am sure everyone in the A.T.C. will understand, these problems could not have been solved. Long and careful training under the Empire Air Training Scheme and in the operational training units meant that Bomber Command must hold back its front-line operational strength for a long time, but this was necessary unless there was to be eventual decline, such as has set in in the Luftwaffe, because the Germans believed in a quick war and made no long-term plans for training and production. Men experienced in bombing Germany had to be sent back to train new crews, instead of continuing on operations; but the delay caused by this and by the long and thorough training of the crews proved amply worth while, when at last a good supply of fully trained crews began to come in.

Experiment

Before the Command had become strong enough, with enough four-engined aircraft and enough fully trained crews, to begin the real offensive, it was decided to try out three major attacks of the kind that would eventually become routine operations. This was in the spring and early summer of 1942, when a thousand bombers were collected by adding the aircraft and crews at the operational training units to the front-line strength of the Command. This force attacked three targets, Cologne, Essen and Bremen, and after that the aircraft and crews were sent back to the training units and there was no further interference with training.

Large Forces Most Effective

But the immense damage in Cologne had definitely proved that twice the normal number of aircraft could do far more than twice the normal damage to the target, largely because of the destructive effect when great numbers of fires are started at the same time. It also proved that in a large force losses are decreased, because of what is known as the "saturation" of defences, which means that when great numbers of aircraft are over the target at the same time the defences can concentrate on only a small number of them and the rest can get through without being attacked.

But this can happen only when the aircraft are over the target within a very short period—it was shown in the Cologne attack that it was well within the capacity of Bomber Command to get 1,000 aircraft over the target within 90 minutes—and after this it became the regular practice to concentrate all the bombers over a German city in as short a time as possible.

Finding the Target

A very serious problem was that of finding and hitting the target. We missed many targets when we first began bombing Germany by night. We had first to find out what we were doing, and this meant that we had to work out a method of taking photographs of the ground while the bombs were going down, a difficult problem which was eventually solved. It was decided then that it would be extremely difficult to hit single factories by night, unless in exceptionally good weather, and the bombers were instead put on to attacking large areas, often a whole industrial town. But this did not mean that the crews were not to aim at a definite point.

In the Pathfinder method which was eventually worked out the Pathfinding crews, chosen from the whole of the Command because of their efficiency as proved by night photographs of the targets they had bombed, dropped markers — really large fireworks, at which the rest of the crews were to aim. In this way the bombs were grouped within the smallest possible area. As the Pathfinder force, with its special methods of finding and marking the target, has constantly increased in efficiency, so our bombing has become more and more destructive. A single major attack has many times wiped out a whole industrial town.

> **"When the war is over Bomber Command's offensive will undoubtedly be considered one of the most striking of all examples of true economy of force in war."**

Countering the Ground Defences

While the Command was expanding so were the enemy's air and ground defences. By the beginning of 1944 the bombing of Germany had become so serious a matter that the Germans had to keep four times as many fighters on the Western front, merely as a defence against bombing, as they then had on the Russian front. I cannot describe in detail the methods by which we have countered such formidable defences, because it is essential not to tell the enemy anything that would help him, but I can tell you that as the enemy's defences have increased the losses among our bombers have gone steadily down. During 1943 they were, on the average, well below four per cent for each force sent out, and in March of 1944 they were lower than they had been for a year.

Direct Results

The results of the offensive have certainly been equal to the effort, and have had far more effect on the German war industries than could have been achieved by the destruction of key factories alone. On the other hand, there is all the difference in the world between attacks on civilian morale and the persistent and methodical destruction of property of all kinds in those large industrial areas where by far the greater part of German armaments is made. These large industrial centres of Germany are not numerous, and the loss of even one of them means a heavy blow to the enemy.

By the end of 1943 one-quarter of the whole area, on an average, of all the towns which had been attacked by then—and only a few towns in the east and south-east of Germany had by then escaped from bombing—had been devastated. As much damage had been done as if three-quarters of the ten largest towns in Britain, excluding London, had been destroyed. Out of 30 industrial cities in Germany with a population of more than 200,000, 13 have now been so badly damaged that they may be counted out of the war effort, so long as they are occasionally revisited by the bombers, which also has the effect of distributing the German defences and prevents the enemy from moving them away from devastated towns.

Effects

It is not so easy to find precise evidence of the total effect of this destruction on German war production or morale. But there are many indications of the now desperate situation of Germany as a result of bombing. The failure to hold the Russian front is certainly largely due to the lack of armaments caused by the R.A.F.'s attacks. There has been serious interference with the building of U-boats. Civilian morale is so bad that only the S.S. can keep people quiet. There are no clothes or furniture for the Germans, and hardly anything can be done to get these for the bombed-out. About three million men are engaged in the defence of Germany, and against the minelaying, done by Bomber Command, which does so much to prevent supplies from reaching the enemy. And some three-quarters of the whole German fighter force has been withdrawn from the support of the German army in an attempt to save the remaining cities of Germany from the fate of Hamburg.

The man-power shortage has become extreme, but men must be found in millions to try to patch up the destruction done by a comparatively small force which employs only a small fraction of our own man-power, service and civilian, and of our natural resources. When the war is over, Bomber Command's offensive will undoubtedly be considered one of the most striking of all examples of true economy of force in war.

'Stringbag' on Conversion COURSE

THE speed on the clock was 170 m.p.h. Four thousand feet below, a sheet of white cloud hid the view of the earth, from whose dim and smoky haze we had just come. Up here the sun was blazing, and one ought to have felt good. However, the tight turn which at that moment I was making tighter and tighter was about to produce unpleasant consequences, and I was frankly expecting the worst.

The monoplanes now in general use in the Fleet Air Arm require much more careful handling than the old biplanes. "Stringbag," who is an officer of the Fleet Air Arm, describes how pilots are taught the new technique.

Now, at 170 m.p.h. on a Miles Master one does not anticipate loss of control by making a normal turn. But this turn was to be very tight; I had been given instructions to stall the aircraft completely. She finally went after a terrible shudder that seemed to shake every nut and bolt in the airframe, and from the turn she flicked over on to her back. For a second or two I hadn't a notion where I was. In due course I sorted this out, and found that the altimeter was registering 5,000 feet.

This was one of the exercises which a number of naval pilots are carrying out at a conversion course from biplanes to monoplanes.

High-Speed Stall

Many of the best pilots in the Fleet Air Arm grew up with Swordfish and Albacores, and on these mounts did prodigious deeds with torpedoes and bombs. Today the F.A.A. has new monoplane aircraft with characteristics which are so different from the biplanes with which we started the war that even for men of experience a conversion course is advisable. To many of the men on this course the words "high-speed stall" were largely a theoretical condition of which they had no experience. It was possible to pull back the stick with almost any degree of violence in Swordfish or Albacores without any risk of fireworks. The importance of appreciating the rather sensational behaviour of a monoplane with a high wing loading after similar violent treatment is well understood by those whose business includes evasive tactics after a torpedo attack. These pilots, after delivering their "tin fish," had been accustomed to removing themselves from the vicinity of the enemy with the sort of flight path associated with snipe. There are limits to which such action is advisable in a monoplane.

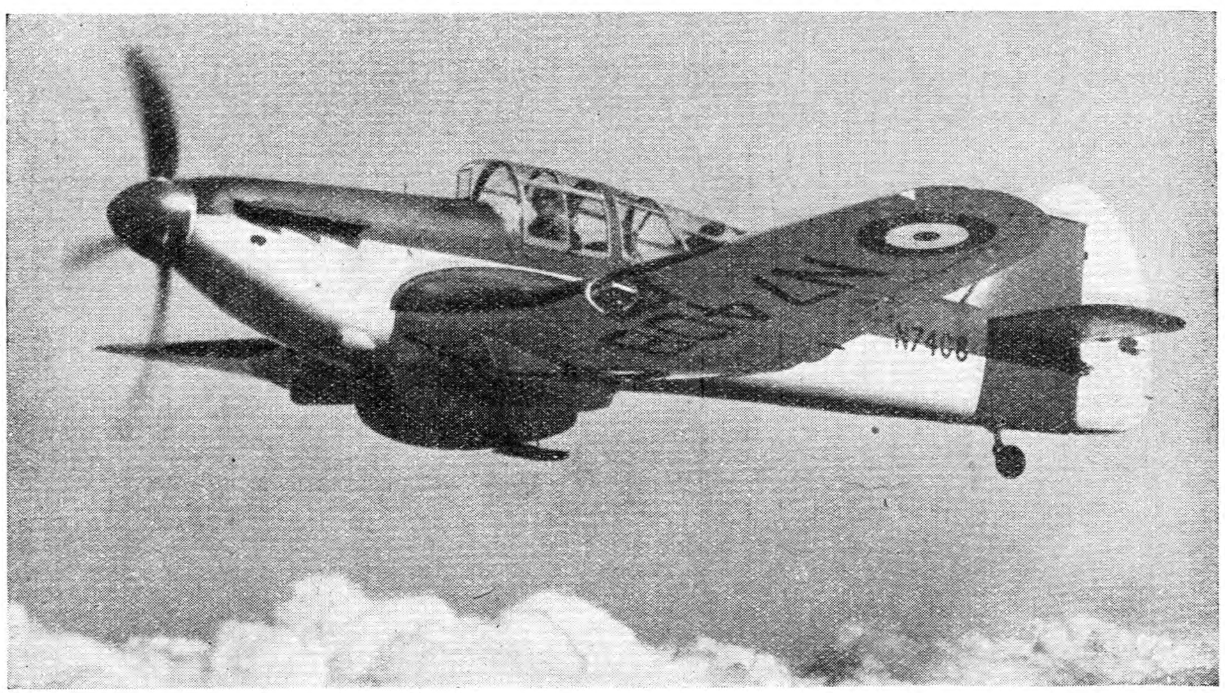
I think it may be true to suggest that many Service pilots have forgotten their elementary-school days, when they were shown the results of the misuse of the controls—and even then it is doubtful whether they practised this misuse in high-speed aircraft. While such a situation would obviously not apply to fighter pilots, it undoubtedly would to many others who have been associated with torpedo-bombers, reconnaissance and multi-engined aircraft.

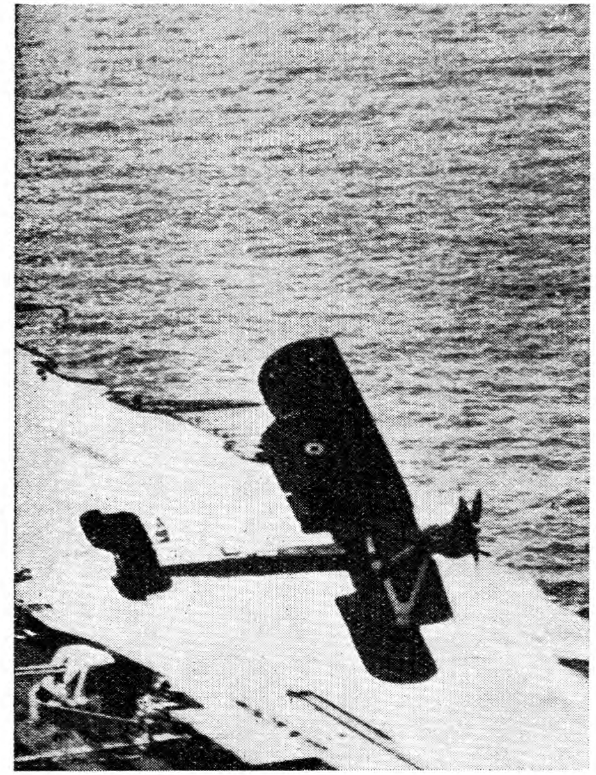
Out of Control

The course opens with demonstrations in a Miles Master of stalls at speeds from 65 to 170 m.p.h. Generally speaking, most pilots are surprised, not to say shocked, at the way a monoplane will fall out of their hands, generally turning on its back, at comparatively high speeds. In the case of the Master, which, after all, is only a training machine and is loaded to only 25 lb. to the square foot, the manner in which it flicks out of control in a tight turn, without any sign of black-out on the part of the pilot, is something of an eye-opener. After one has "gone for six" and recovered half a dozen times from various speeds, one has learnt something which is valuable.

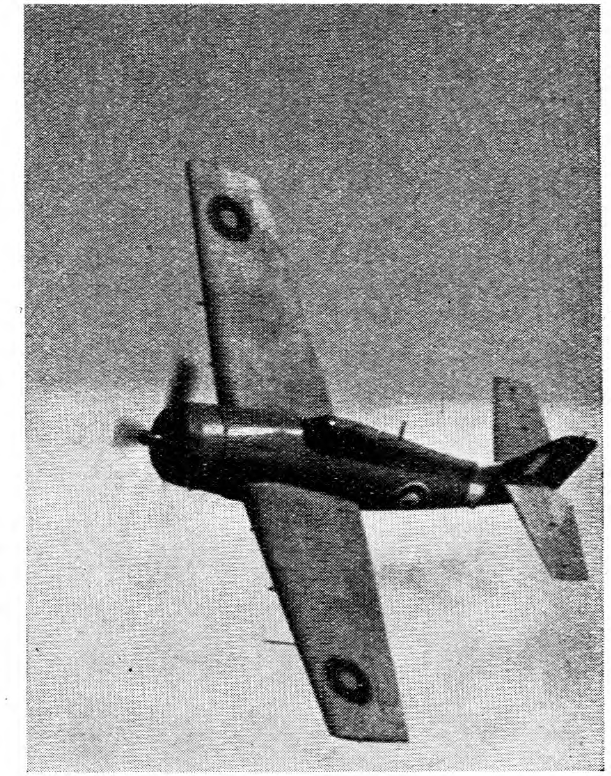
The subsequent demonstrations are designed as an insurance against disaster when coming in to land on a carrier. Turning in with flaps and undercarriage down and a little engine on is a normal and absolutely safe procedure, provided that speed is

The Miles Master is used for conversion courses. This is a Mark I.





You can do things with a Swordfish . . .



which would get a Wildcat's back up.

maintained. One learnt this at one's elementary flying school. But it remains a tragic fact that many of the fatal accidents which occur happen at just this moment. The introduction of high-speed monoplanes with a wing loading which not long ago would have been regarded as tremendous, has quadrupled the risk—but risks which are attendant only on bad flying.

"We tighten the turn and . . ."

Stalling off a gliding turn with flaps and undercarriage down and a little engine on is undoubtedly the most sick-making manœuvre which it is possible to execute. The aircraft flicks on its back without warning, and sometimes almost completes a diving roll. The instructor will be talking on these lines: "We are now turning in to land on the deck. You will notice that the speed is 90 m.p.h., which is quite safe for this gentle turn . . . but the wind is driving us a little sideways. . . . We must tighten the turn to line up with the deck again . . ."; and as he tightens the turn a trifle to line us up the aircraft falls out of his hands in a fraction of a second. We hurtle downwards, and I am hanging on the straps. If we weren't 7,000 feet up we should not have long to worry.

Once again continuous practice at intentional stalling of the aircraft gives one absolute confidence and the definite knowledge of the point of safety.

Leave the Rudder Alone

The last and final demonstration will reveal the results of the biplane pilot's trick of using his rudder to commence a violent evasive turn. If a Swordfish is low on the water and is being shot at, it is possible to throw the aircraft round with a colossal thrust at the rudder, followed by pulling back on the stick. The rudder initiates a skid, and the skid in turn presents the side of the fuselage to the airflow, and the fuselage itself blankets off the inner part of the inside wing. If you do this in a monoplane this inside wing will stall, and once again you find yourself on your back. If you have done this half a dozen times you are convinced that the correct way to take violent evasive action is to make a correct turn and, as far as possible, to leave the rudder alone.

How the Weight Increases

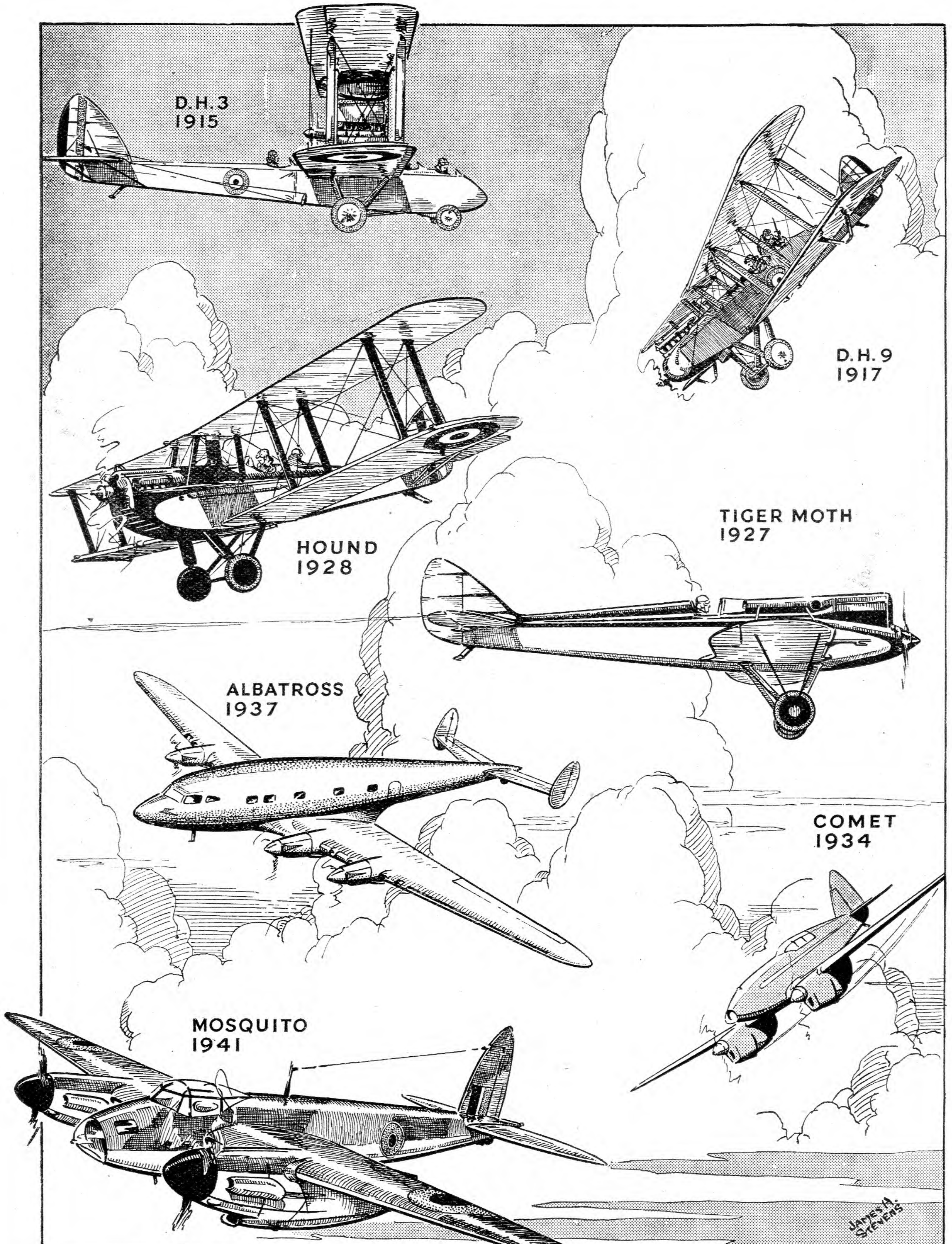
Back on the ground the pilots learn a simple mathematics. They are reminded of a very simple principle, which those who have been flying biplanes are apt to overlook—it is just that a change of direction which puts 3 G on the aircraft will multiply its effective weight by three times. In other words, the wings of an aircraft weighing 10,000 lb. will have to support a weight of 30,000 lb. in a turn. The big wing area of a biplane will support the load, but the infinitely smaller wings of the monoplane will stall. In the first case it will put an initial wing loading of, say, 20 lb. to the square foot up to 60 lb.; while in the second it will increase an initial loading of 35 lb. to 105 lb.

The Angle of Attack

There is another thing which some of us also forget—that the stall is influenced by the angle of attack. Most wings will stall when the angle of attack exceeds 18 degrees, regardless of speed. This becomes suddenly important when pulling out of a dive during a bombing or torpedo attack. If the attitude of the aircraft is altered so that the airflow exceeds this angle, there is only one possible result.

It Pays to be "Converted"

You can tell a pilot these things and he will believe you. But in order to ensure that the lesson has sunk into his subconscious mind it is necessary to prove their truth over and over again at a safe height. The final result is a pilot who can deliver the goods in the face of the enemy and return to tell the tale. He has been under fire, probably intense fire, and he has flown his aircraft to the limits of its manœuvrability. But those limits have never been exceeded, because he has subconsciously checked each "extravagance" as it became dangerous. In this way does a conversion course pay its dividends.



The DH Line

JAMES HAY STEVENS

DE HAVILLAND aeroplanes have always been recognisable for a "sit" of their own. This appearance has not been caused solely by the familiar shape of the D.H. tail, for the designs have almost always represented the latest aerodynamic ideas of the day. There have been almost 100 de Havilland aeroplanes designed to date, so it is not possible to show all of them, but I have selected six ancestors of the Mosquito that can be said to show distinct stages in its evolution.

How It Started

After he left the Royal Aircraft Factory (now the R.A.E.) at Farnborough, where he had been responsible for the design of the early B.E. biplanes, Captain Geoffrey de Havilland joined the Aircraft Manufacturing Company. Here he produced many famous aeroplanes of the 1914-18 War, of which the third was the D.H.3. This aeroplane was not one of the best or most successful products, but it is shown here because it was one of the earliest twin-engined aeroplanes to be built on modern lines. Note how the fuselage shape of this aeroplane of 1915 follows that of the familiar Dominie. The D.H.3 was powered by two 160-h.p. Beardmore engines, and with a loaded weight of about 5,800 lb. had a maximum speed low down of 95 m.p.h. The span was 60 ft. 10 in.

Two years later, in 1917, the best-known de Havilland was the D.H.9, a single-engined day bomber. The type was a straightforward two-bay biplane with what was for those days a very clean fuselage. The installation of the water-cooled in-line engine with the protruding cylinder block and underslung radiator was unusual, and gave the machine an appearance not unlike the early Cirrus Moth of 1925. The performance of the D.H.9 was good: with a 240-h.p. B.H.P. engine, and a loaded weight of 3,900 lb., the maximum speed was 110 m.p.h. at 10,000 ft. The landing-speed was quite high for its day—57 m.p.h.! The span was 42 ft. 4 in.

Long after 1918 the D.H.9 was a standard type in many of the smaller air forces, while I remember seeing one used for banner-towing a few months before the start of the present war—an amazing life of over 20 years.

Peace Products

Between the wars the de Havilland Company was one of the few British firms to concentrate on the design and development of civil aeroplanes. Making a success, in 1925, of the first practical light aeroplane, the Moth, it went on to develop a long line of civil aeroplanes of all sizes.

One of the few military aeroplanes produced by de Havilland's was the Hound of 1927, which was entered for a competition for a replacement for the D.H.9a, then the standard general-purpose day bomber of the R.A.F. The Hound, with a 450-h.p. Napier Lion water-cooled W-type engine, had a maximum speed of about 160 m.p.h.

James Hay Stevens outlines the progress of the de Havilland designs from the last war and shows how the Mosquito has developed from the many designs produced by de Havilland's for peace-time use.

It is interesting to see how like the 1917 aeroplane the Hound was; it was really a cleaned-up and rather larger D.H.9.

The First Tiger

In the same year that the Hound was built the lovely little Tiger Moth appeared. (The name Tiger Moth was later given to the biplane trainer.) The Hound was the end of one era, the Tiger Moth the beginning of another: the end of the slow, easily handled biplane, the beginning of the high-performance monoplane.

There were two of these original Tiger Moths, which were racers built for the 1927 King's Cup Race. Even today it would be difficult to make a small aeroplane that would be cleaner than this tiny racer. The engine was one of the first four-cylinder Gipsies, tuned to give 130 h.p. Prior to the Tiger Moth, de Havilland types usually had plywood- or fabric-covered fuselages. Now the monocoque wood, the germ of the idea that was to develop into the Mosquito, appeared for the first time. Another special feature of the Tiger Moth was the use of the rigid undercarriage with internally sprung wheels.

With a span of only 19 feet the Tiger Moth, piloted by Hubert Broad, set up a light-aeroplane world's speed record over 100 km. (62 miles) of 186.4 m.p.h. in August 1927.

The Comet

De Havilland types were developed on conventional lines, until the company was asked to build three racers for the MacRobertson Trophy Race from England to Australia in October 1934. At the time of this race most British designers were clinging lovingly to fabric-covered metal or wooden biplanes for all purposes, while the Americans had got well started on metal stressed-skin monoplanes. Knowing what had to be beaten and having only about eight months in which to build and test the aeroplanes, de Havilland's chose to make a small aeroplane with two of their own Gipsy Six engines. It is amazing to look back a bare ten years to find that in this country we had no high-speed monoplanes, only about two (comparatively low-powered) aeroplanes with retractable undercarriages, and no variable-pitch airscrews.

In a very short time the Comet was designed, as a two-seater "flying petrol tank," and three examples were built and test-flown a few days before the start of the race. The fuselage was just large enough to contain a crew of two and two large fuel tanks. This fuselage was mounted on a slender wing of stressed-skin wooden construction. The two 200-h.p. Gipsy Six engines were mounted in underslung nacelles and were fitted with Ratier two-position v.p. airscrews. These Ratier airscrews were curiously simple in operation, but sadly lacking in one respect. In order to save weight they had a very simple mechanism for changing from fine to coarse pitch *only*. To see a Comet "going round again" in coarse pitch after a baulked landing was a startling sight. However, despite difficulties, one of the Comets, piloted by C. W. A. Scott and T. Campbell Black, won the race by covering the 11,300 miles in two days, 23 hours, an average ground speed of 160 m.p.h. The actual maximum speed of the Comet, when fitted with proper c.p. airscrews, with which several record flights were made, was about 230 m.p.h. Not fast by present standards, but still remarkably good for the low power and the long range.

The Albatross

In 1937 the Albatrosses were built—some as air liners for Imperial Airways and some as long-range mail-planes for the Air Ministry. In appearance the Albatross was striking, with a large beautifully shaped fuselage mounted on a slender wing. That fuselage could hold from 22 to 30 passengers in great comfort, and yet, with a cruising power of only 1,280 h.p., the speed was 210 m.p.h. To appreciate just how aerodynamically efficient this aeroplane was, it should be compared with its excellent contemporary, the Douglas DC-3. This aeroplane, with a less spacious cabin for 21 passengers, had a *maximum* speed of 212 m.p.h. on 1,700 h.p.

In addition to its remarkable cleanness, the Albatross was unusual in having a moulded balsa and plywood fuselage. The skin of the fuselage, instead of being mounted on frames and stringers to give it shape and prevent it from buckling, was self-supporting. All the main loads were taken by the inner and outer plywood shells, which had between them a thick layer of balsa wood—this "stuffing" of balsa supported the skins in their correct shape and allowed them to develop their full stress without wrinkling. This fuselage was made in one piece on a collapsible mould.

The four engines of the Albatross were the 375-h.p. Gipsy Twelve air-cooled inverted vee. The span was 105 feet.

The Mosquito

The culmination of this development that I have tried to outline is the Mosquito. In this aeroplane can be seen the application of the experiments in structure and the refinement of line that went into the earlier types. Even here can be seen the familiar D.H. tail—still essentially the same as that on the D.H.3 of nearly 20 years ago.

The Mosquito is too well known todav for it to be worth my going into details here, but some of the main features may bear repetition. The balsa-ply sandwich is used on the fuselage; only this time, instead of being made in one piece, the fuselage is moulded in two halves. Into these halves most of the "plumbing" and equipment are fitted before they are joined. The wing is built up with a cellular skin developed, through the Albatross, from that used on the Comet.

The performance given to the Mosquito by its two Merlin engines has not been released, but a few odd facts may be of interest. The span is 54 ft., and the wing loading 40-50 lb./sq. ft., giving a landing-speed with flaps of about 110 m.p.h. This high landing-speed gives little trouble, owing to the fine control characteristics right down to the stall.

Mosquitoes are used as bombers (their designed role), fighter-bombers, fighters and for P.R. (photographic reconnaissance) duties. In March of this year it was announced that they now carry a 4,000-lb. bomb, four times the original designed bomb load. What will be the next step?

Watch your ENGINE'S HEALTH

J. A. Kyd

IN spite of all the instruments provided for checking the performance and functioning of an aero-engine, the most valuable guide to its health probably lies in the "feel" of the engine that can be sensed by the pilot or flight engineer of long experience when he is handling the engine controls. Naturally, in a multi-engined aircraft, when all the engines are running, this is not very practicable; but during the running of individual engines on the ground or during flight in a single-engined aircraft, the pilot or flight engineer can often sense a defect even before it is sufficient to show on the instruments. Call this intuition, or what you like, but it is a fact that an experienced man can feel the pulse of an aero-engine to as high a degree of accuracy as the average cockpit instrument.

Only long experience of engine operation will enable a person to acquire this intuition, but there are other outward and visible indications to an engine's health which can be of great help in tracking small and large defects. If notice is taken of these indications it will usually be found that the troubles to which they point can be confirmed by instrument readings which otherwise might have gone unnoticed.

Possibly the most telling of these indications is the state of the exhaust flames. In broad daylight it is not always possible to observe closely the colour of the exhaust flame, and, moreover, the exhausts are often shrouded, but nevertheless the following description of what to look for and how to interpret what you see is very well worth while absorbing, and it has been found of great value in practice.

In-line engines sometimes have separate exhaust stub pipes for each cylinder, in which case not only can you see a general defect which affects all the cylinders, such as faulty carburation, but also defective burning in individual cylinders through a fault such as badly worn valve guides will at once be obvious. Modern radial engines, however, are usually provided with an exhaust collector ring, with one or two outlets, so that only a general defect affecting the whole engine is really obvious. Defects in individual cylinders may, of course, make themselves shown in the exhaust flame to a minor extent, but other means would have to be used to determine which cylinder was at fault.

The exhaust from a normal engine should be almost invisible, even in the dark. The pipe out of which it comes will probably glow red, but all that should be seen is an area of shimmering heat.

The not-so-good exhaust flames and their causes are as follows:

1. *The washy-blue flame sometimes verging on green* is caused by a weak mixture being fed to the cylinders. This means that the ratio of air to fuel is too great. It is usually caused by faulty carburation through such things as incorrect or choked jets. An insufficient fuel flow to the carburettor would also cause a weak mixture. On unsupercharged engines worn valve guides and cracked induction manifolds will allow additional air to enter the combustion chambers, but in the case of supercharged engines this would occur only when the engine is running at a very low boost, with, consequently, a negative pressure in the manifold.

2. *A deep blood-orange flame at the end of the exhaust pipe that vanishes and reappears further from the exhaust pipe as an area of bluish flame* denotes a rich mixture. Exceptionally bad cases will have black smoke emitting from the exhaust as well. Rich mixture is due to the ratio of air to fuel being too small. As in the case of the weak mixture, it is usually caused by faulty carburation. A carburettor prone to flooding will also cause a rich mixture.

3. *A smokey blue exhaust* indicates that oil in considerable quantity is finding its way into the combustion chamber. It will usually be due to worn cylinders (although it will not occur suddenly) or defective or broken piston rings. Both these causes would allow the oil-laden vapour in the crankcase to work its way up past the pistons, and thus get burnt with the normal mixture.

If the oil scavenge system is faulty a reservoir of oil will build up in the crankcase, and some of it will find its way into the combustion chambers in spite of the piston rings. Clouds of blue smoke are often blown out of the exhaust pipes when an engine is started up. This is usually due either to oil draining into inverted cylinders when the engine has been standing some time or, if the engine has been in store, to the oil which has been put into the cylinders before storage to prevent corrosion. In these cases the exhaust usually becomes normal after one or two minutes' running.

4. *An irregular, long, pale orange flame* appearing only occasionally, with sometimes a puff of black smoke accompanying it, indicates that detonation or pre-ignition is taking place within the combustion chambers. Detonation is incorrect burning of the mixture in the combustion chamber; instead of burning progressively, spontaneous combustion occurs at a point remote from the normal source of burning, and it imposes a shock load on the piston instead of the normal progressive application. Detonation may be caused through fuel of an incorrect octane value being used.

Pre-ignition is combustion of the mixture in the combustion chamber due to some cause other than the sparking-plug. It is usually caused by defective cooling of the cylinder heads allowing carbon deposit to burn, and thus explode the charge as soon as it becomes sufficiently combustible and before the plug points are timed to spark.

SOME DISTINGUISHED FLYERS

1, F/O T. E. Jonsson, D.F.M.; 2, F/O S. C. Sukthanker, D.F.C.; 3, F/Lt. D. C. Dougall, D.F.C.; 4, F/Lt. D. R. Morrison, D.F.C., D.F.M.; 5, S/L. R. F. Hamlyn, A.F.C., D.F.M.; 6, F/Lt. P. B. Laing-Meason, D.F.C.; 7, Acting F/Lt. R. W. Turkington, D.F.C.; 8, F/O C. Mason, D.F.C.; 9, S/L. D. H. Duder, D.F.C., D.S.O.; 10, W/Com. H. N. G. Wheeler, D.S.O., D.F.C. and Bar; 11, W/Com. J. Hurry, D.S.O., D.F.C.

Blind Faith and Blind Flying

BY 'SURGEON COMMANDER'

THOUGH the ear is the organ of hearing, the inner ear has another and totally different function as an organ of balance, whose secrets should be understood by all who have to fly blind.

In everyday life we use three senses to tell us our position in space. First and foremost we rely on our eyes; but we do not fall down in the dark, for we have two other senses to guide us—our "muscle sense," which tells us by feel whether we are standing on our feet or on our heads, and our organ of balance, which informs us whether we are swaying or turning.

It is the combined messages from all three sources, interpreted by the brain, which gives us a true picture. The most reliable guide is our eyes. Nevertheless, a blind man going round a sharp corner in a car can tell which way he is turning, for he will be swung outwards and he will feel a much increased pressure on that side of his "sit-upon," and his sense of balance will confirm the turn.

But an aeroplane pilot in a perfect turn puts on exactly the correct amount of bank to prevent any such swing, and a blind passenger will merely feel that he is pressing more firmly, but quite evenly, onto his seat. This same impression, however, is conveyed during the climbing part of a loop or straightening out of a dive, and so one cannot get a true idea from the sense of feel alone, which leaves only the balance mechanism to tell us our position.

Secrets of the Semi-Circular Canals

Flying blind through fog, cloud, or on a pitch-black night, we should be in a tight corner if we had only our unreliable "muscle sense" and our organ of balance to guide us, as this last sense has serious limitations, and tells us only part of the truth. So that the moment our eyes become U/S we are left with two very easily deceived senses which will lead us to swift disaster if we put our trust in them.

If we examine the mechanism of balance more closely and see how it works, we shall understand why it tells the brain, in all innocence, such dangerous lies, and is, in fact, a menace in blind flying.

Situated alongside the inner organ of hearing in the skull, it is made up of three semi-circular canals—one lying in the horizontal plane, the second standing in the fore-and-aft plane, and the third standing in the transverse plane. (See diagram.)

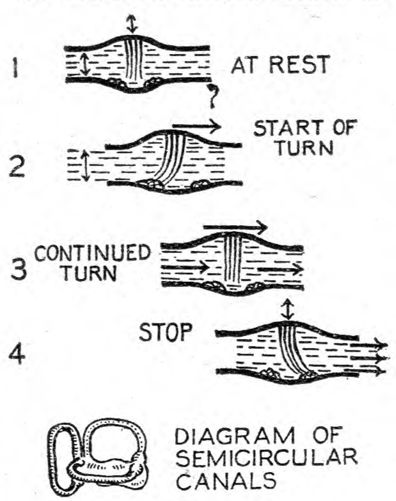
Each canal is filled with fluid, and nerve-endings resembling hairs grow from the lining of the walls, floating out like reeds on the bottom of a stream. On the wall opposite these nerve hairs are two small lumps of chalk (Fig. 1). When we turn our heads sharply the bony canals and nerve-endings turn as one, but owing to lack of friction the fluid has a distinct time-lag and does not pick up the rotation for some seconds.

It is generally known that you can't believe your senses when you are flying blind, and that you must trust your instruments implicitly. The Surgeon-Commander explains exactly why this is so and gives some useful tips.

The hair-like nerves are therefore dragged through the fluid and swung against the chalk lump opposite and tickled, sending a message to the brain that "the head is turning" (true) (Fig. 2).

If we continue to turn the head the fluid will catch up to the same speed after 5-25 seconds. The nerves are no longer bent, and they report that "all movement has ceased" (false) (Fig. 3.)

Slow down the turn, and the fluid will now be revolving faster than the bony canal. The nerves are bent in the opposite direction by the fluid, and send a message, "You are turning in the opposite direction" (still false).



Now stop turning, and the fluid will continue to revolve for a while. The nerves are bent even more strongly, and report, "You are turning still faster in the opposite direction" (a dangerous lie in blind flying!) (Fig. 4).

Exactly similar false impressions in the fore-and-aft plane are given when diving and climbing, as you can work out for yourself. You may feel that you are climbing and yet be diving through fog to earth!

Seeing is Believing

We can see this if we get a tumbler of water, sprinkle some cigarette ash on the surface to indicate how the water is moving, and give the tumbler a twist. At the start of the twist the water, as shown by the ash, fails to move. When the twist is checked the tumbler stops revolving, but the water continues turning for a second or more.

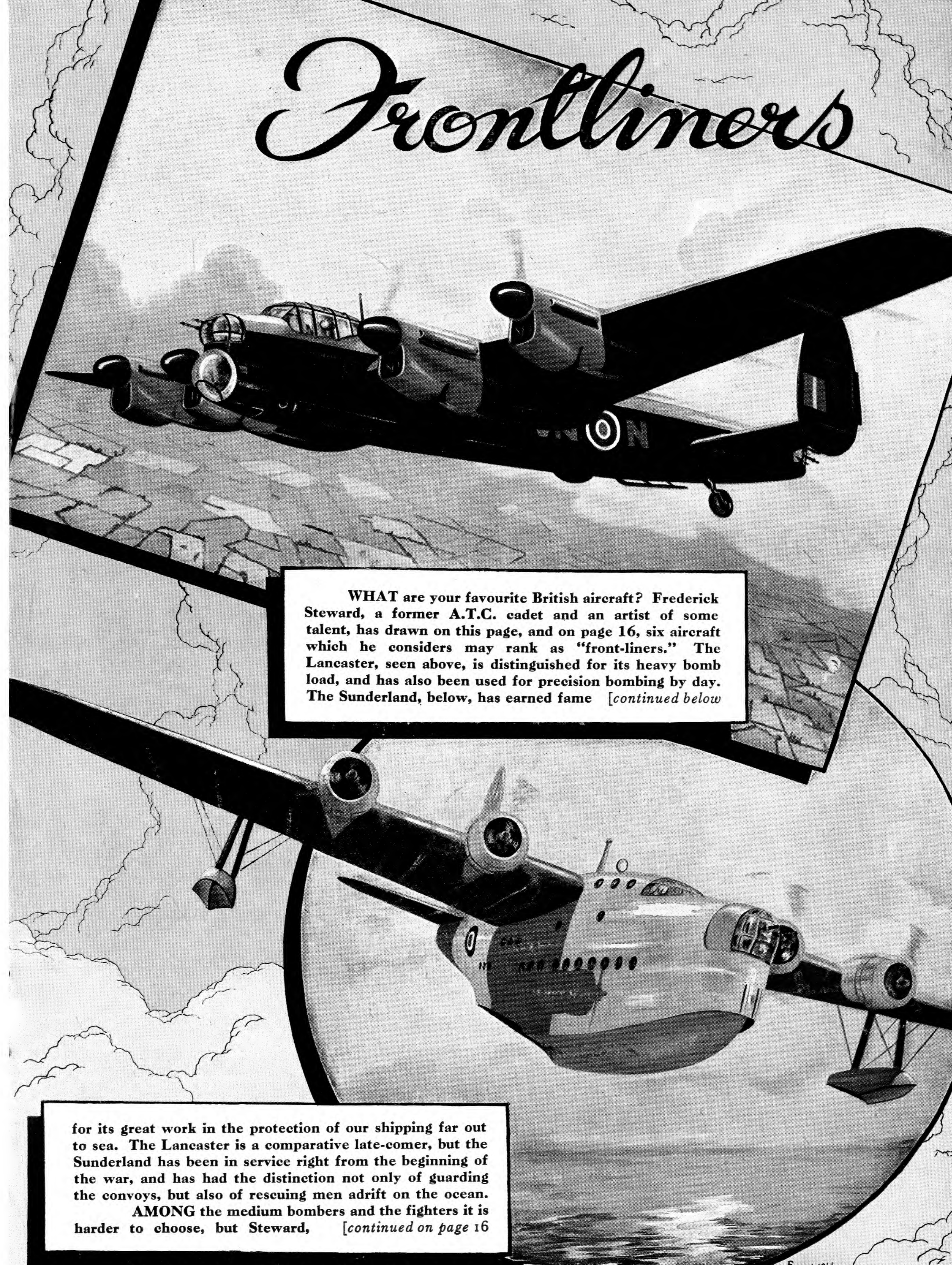
Even better: cut half a dozen hairs about 1½ inches long from your head. Touch the ends with glue, and stick the bunch inside the tumbler so that they stand out at right angles from the glass. When the glue is quite dry you will have a rough working model of a semi-circular canal.

You can test the unreliability of your own semi-circular canals by sitting on a music-stool with your eyes shut and getting a pal to revolve it steadily but fast, then slowly and finally stopping. Report what you feel and open your eyes. The same can be done in a Link Trainer. If you stall a Link and straighten out with your eyes shut, the need for instruments is at once apparent.

By using precision instruments in blind flying we regain the use of our most reliable sense, that of sight. The essentials are the altimeter and the turn and bank indicator. With these alone one can fly level in cloud, but it needs a quick wit to interpret their message and translate it into correct counter-action, so we have the rate of climb and descent indicator and the artificial horizon to give a visual picture of the relation of the horizon to the 'plane. Even so, gyroscopes can be toppled, and take time to recover, and it is advisable not to do more than rate-1 turns when flying blind by instruments.

CONTINUED ON PAGE 17

Frontliners



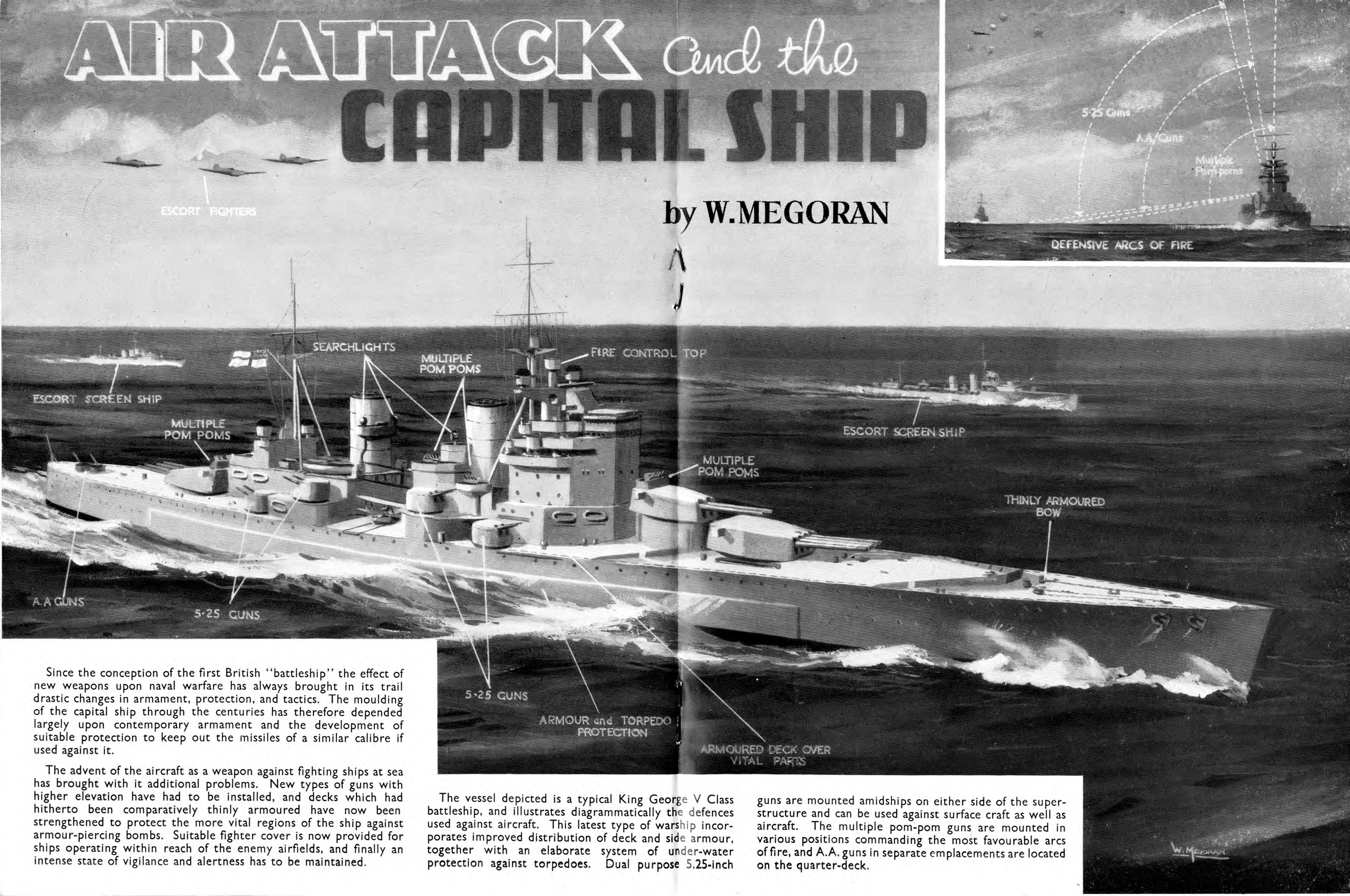
WHAT are your favourite British aircraft? Frederick Steward, a former A.T.C. cadet and an artist of some talent, has drawn on this page, and on page 16, six aircraft which he considers may rank as "front-liners." The Lancaster, seen above, is distinguished for its heavy bomb load, and has also been used for precision bombing by day. The Sunderland, below, has earned fame *[continued below*

for its great work in the protection of our shipping far out to sea. The Lancaster is a comparative late-comer, but the Sunderland has been in service right from the beginning of the war, and has had the distinction not only of guarding the convoys, but also of rescuing men adrift on the ocean.

AMONG the medium bombers and the fighters it is harder to choose, but Steward, *[continued on page 16*

AIR ATTACK and the CAPITAL SHIP

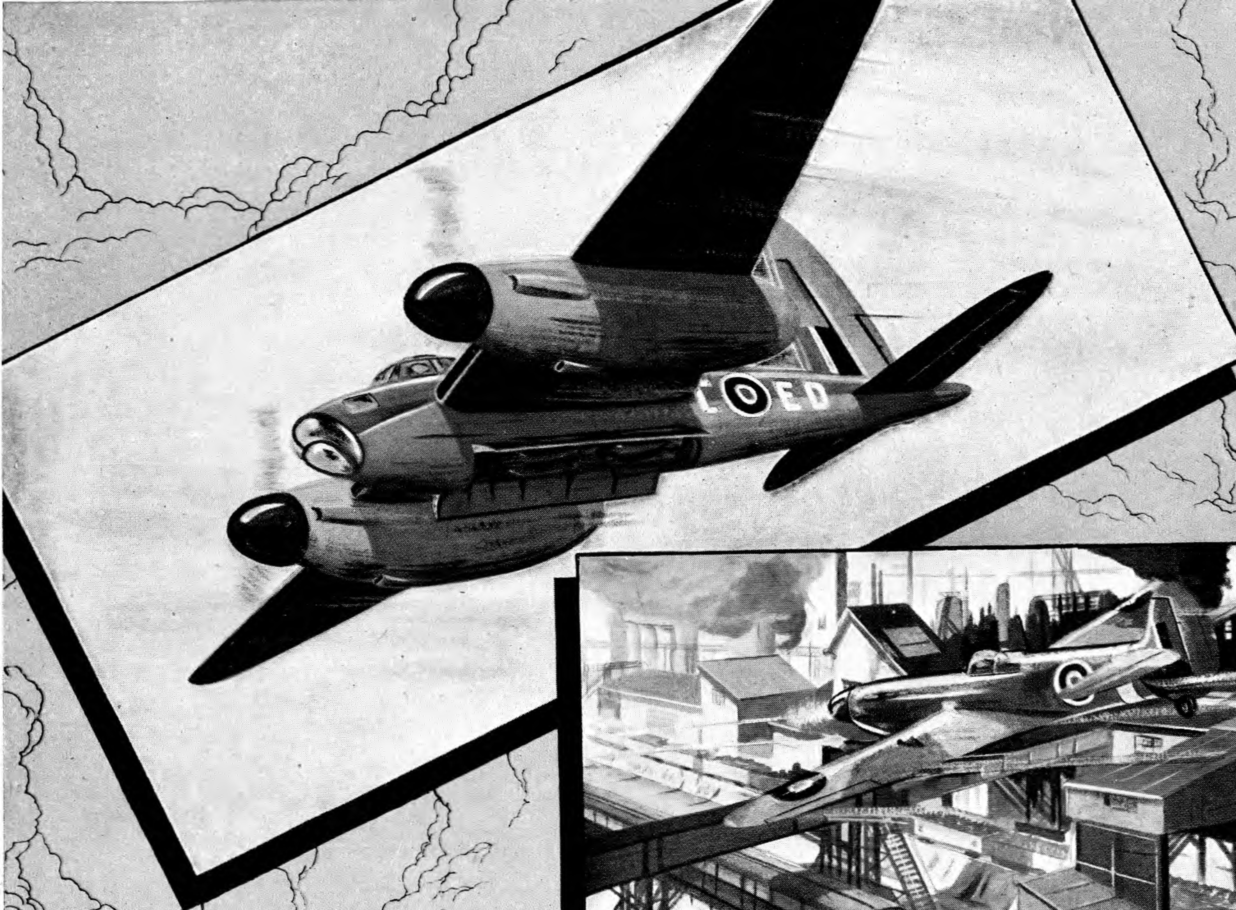
by W. MEGORAN

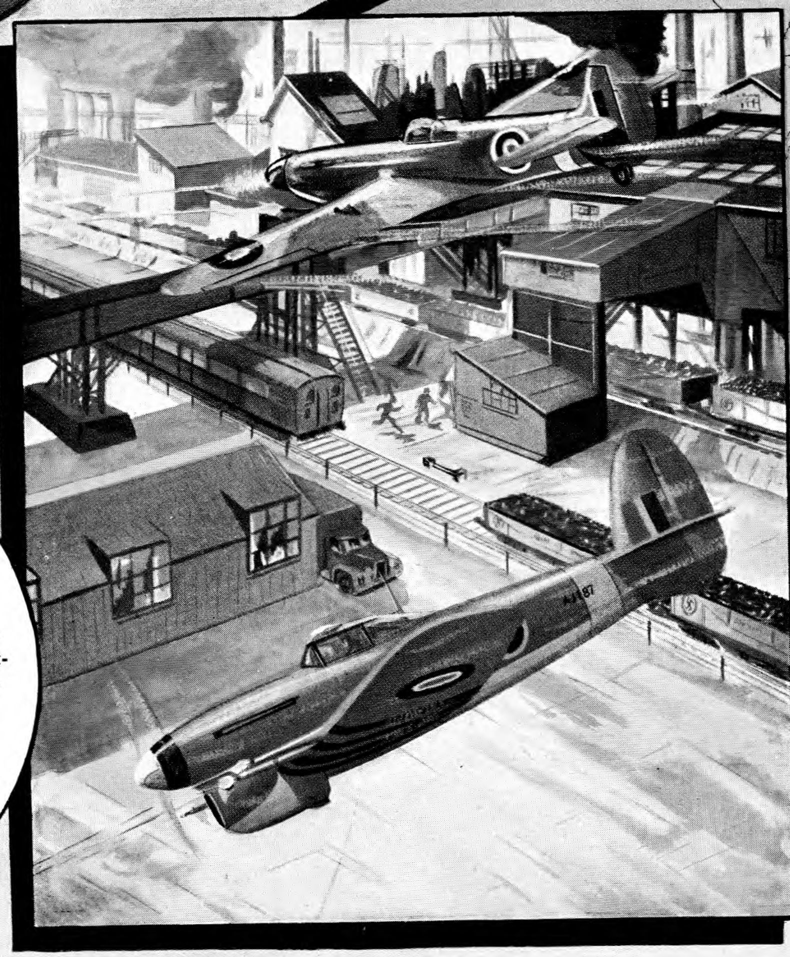


Since the conception of the first British "battleship" the effect of new weapons upon naval warfare has always brought in its trail drastic changes in armament, protection, and tactics. The moulding of the capital ship through the centuries has therefore depended largely upon contemporary armament and the development of suitable protection to keep out the missiles of a similar calibre if used against it.

The advent of the aircraft as a weapon against fighting ships at sea has brought with it additional problems. New types of guns with higher elevation have had to be installed, and decks which had hitherto been comparatively thinly armoured have now been strengthened to protect the more vital regions of the ship against armour-piercing bombs. Suitable fighter cover is now provided for ships operating within reach of the enemy airfields, and finally an intense state of vigilance and alertness has to be maintained.

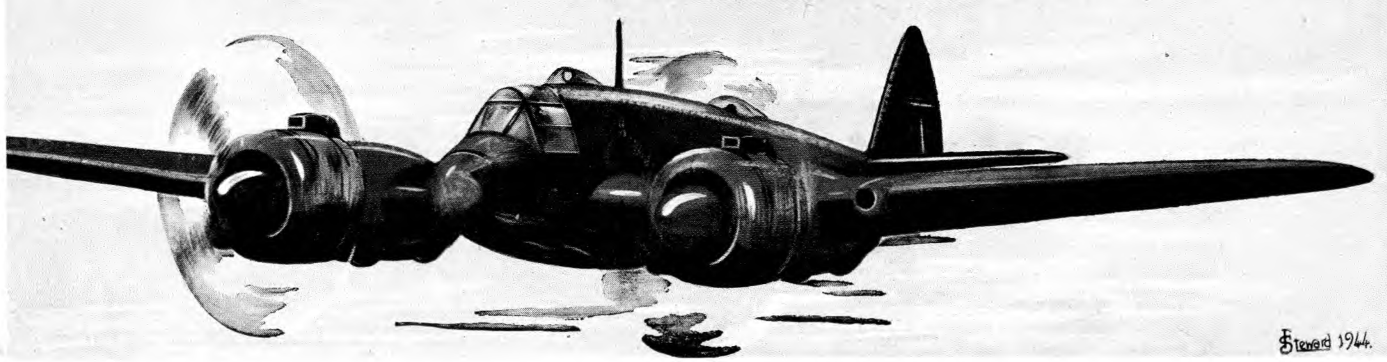
The vessel depicted is a typical King George V Class battleship, and illustrates diagrammatically the defences used against aircraft. This latest type of warship incorporates improved distribution of deck and side armour, together with an elaborate system of under-water protection against torpedoes. Dual purpose 5.25-inch guns are mounted amidships on either side of the superstructure and can be used against surface craft as well as aircraft. The multiple pom-pom guns are mounted in various positions commanding the most favourable arcs of fire, and A.A. guns in separate emplacements are located on the quarter-deck.





[*Continued from page 13*]

taking two of each, has chosen the Mosquito (above) and the Beaufighter (below)—the Mosquito for its speed and audacious precision raids in the heart of the enemy's country, and the Beaufighter for its deadly work as night-fighter and long-range fighter. The Spitfire and the Typhoon, seen on the right (unusually close together and dangerously close to enemy earth), make up the set of six. It's all a matter of opinion. Work out your own selection of "front-liners."



BLIND FAITH AND BLIND FLYING

CONTINUED FROM PAGE 12

Remember the cardinal rule: when flying blind rely absolutely on your instruments. It may be difficult at first, but you will never fly blind with confidence unless you learn to ignore what you feel.

Feeling is Phoney

Here is a report written at the time while flying blindfold as a passenger on a test flight in daylight. The pilot's report (actual movement of aircraft) is given first, and the blindfolded passenger's impressions (muscle and balance senses) follow in italics.

TURNING.—Steeply banked (rate 3) turn to left . . . *Turning to left, slight bank.* Continuing in tight level turn . . . *Climbing in gentle turn to left.*

360 degrees turn complete; ran into own slipstream and aircraft thrown about . . . *Slight turn to right—straight — left — climbing — dive — straight.*

STALLING. — Stall, without turning . . . *Flying straight and level (but conscious by fullness in ears that 'plane must be sinking).*

DIVING. — 4,000 feet. Sharp left-hand diving turn until banked slightly over vertical . . . *Turning left (about rate 1).* Straightened into nearly vertical (80 degrees) dive with engine throttled back . . . *Climbing.* Still diving at 190 knots . . . *Reported after eight seconds "flying straight and level"!* 1,000-500 feet; pulling out . . . *Turning slightly to left, then to right in a hard banking turn.*

Why the last impression of a hard turn when the aircraft was really being pulled out of a dive? The answer is that the air was bumpy. The 'plane yawed slightly (left turn). This was instantly straightened (impression of right turn), and the pressure of the seat in pulling out gave the feeling of a hard banking turn to right. What tickled the pilot was the report "flying straight and level" while diving at 190 m.p.h.

Even pigeons, with their wonderfully developed flying and direction sense, will glide quietly to earth when blindfolded. They do not trust to their other senses when deprived of sight.

Prawns have grains of sand at the base of feelers as their balance organ. These are shed on moulting. Given only iron filings to replace the sand they can be persuaded to swim upside down by the use of a magnet.

A neat yarn is told of a fighter pilot who was overtaking another one from above in haze. For a joke he turned upside down and pointed at the other pilot, who promptly rushed into the upside-down position, too.

Two other points: Glance at your instruments before taking off in the dark. If the artificial horizon is canted out of the level and is U/S, it is better to notice it before than after taking off.

When taking off on a dark night the flare-path or deck-lights give you a visual guide and horizon, but however good your night vision is, transfer your eyes to your blind-flying instruments as soon as you are airborne, otherwise you will be looking into a darkness without horizon as soon as the flare-path recedes, and you may hit the deck or the drink.

Tips

1. In blind flying, if your senses contradict your instruments put absolute faith in your instruments. Ignore your feelings.

2. Do not tempt the gods by doing more than rate-1 turns.

3. Read your blind-flying panel as you read words. Glance over and read all the instruments as a whole. Don't concentrate on one and forget the others.

4. Check your instruments before taking off.

5. Transfer your gaze on a dark night from the deck-lights to the instrument panel as soon as you are airborne.

Having Ears, We Hear Not

Now for the ear that hears.

It consists of three parts—an outer collecting trumpet and tube which leads into and is sealed off by the ear-drum; behind the drum is a cavity called the middle ear; and beyond the cavity is the bone of the skull, with the inner organ of hearing, alongside the organ of balance.

It is the middle-ear cavity which is of importance to airmen.

At a height of 34,000 feet the pressure on the outside of the drum is very low, and if it were a sealed cavity the air inside the cavity would remain at ground-level pressure, and expand until it was pressing the ear-drum outwards with a pressure of $2\frac{1}{2}$ lb., concentrated onto an area about half the size of a sixpence, which would be painful. Fortunately, nature provides an equalising channel for these differences of air pressure by means of a tube (the Eustachian tube) which leads from the cavity of the middle ear to the back of the throat behind the tonsils. It is valved, and air under pressure can escape, but cannot enter except when the valve is opened, which it is every time we swallow. This we all do frequently and unconsciously.

In climbing into a rarefied atmosphere the air escapes down the Eustachian tube and pressure is equalised on either side of the drum. In diving down to denser atmospheres the pressure outside increases again. If one forgets to swallow for some seconds the greatly increased pressure may press on the valve so firmly that mere swallowing won't open it, and the drum becomes pushed in, painful and slightly deaf. There is only one thing to do. Hold the nose and blow really hard, until air is forced up into the middle ear, when the pain will disappear and hearing will come back.

Fighter pilots yell and shout when diving on the enemy, as this helps to increase the pressure inside the head, but if you are one of a crew, and yell without remembering to turn off your intercom., you will be unpopular.

There is as great a difference in atmospheric pressure from 4,000 feet to zero as from 60,000 feet to 38,000 feet, so that diving from low level in torpedo attacks can still cause considerable pressure on the ears.

If one has a bad head cold and the ears feel "woolly" it is best to avoid dive-bombing. Forcing air up into the ears in the presence of a head cold may carry with it some infected mucus or pus, and shooting this up into the ear may cause an ear-abscess.

There are other cavities or sinuses in the head entering the nose, one behind each cheekbone and one over each eye. These may be affected in the same way as the ear, causing "vacuum headache."

Sea-divers have to report to the medical officer before diving, and are not allowed to dive with heavy head colds. They get extra pay for diving, and if they don't understand or care about their ears they may try to convince the M.O. they are all right.

It is left to the individual airman to report if he has a cold.

A.T.C. Boxing Championships

THE A.T.C. Boxing Championships held at the Albert Hall on May 8th attracted a full house. Ably organised by Wing Commander Keat, the tournament proceeded swiftly and efficiently from bout to bout. Most of the fighting was first-class and all of it high-spirited and fast. The South won 11 of the events. London Command took the Harewood Trophy, and Southwark (1061) Squadron won the Silver Wings trophy presented by the *Star*, five of its six finalists having collected trophies. The winners were:

Juniors.—7st., C. W. Booker (Southwark); 7st. 7lb, R. G. Griffin (Mid-Sussex); 8st., T. Rooke (Brighton); 8st 7lb., H. Arthur (Birkenhead); 9st., P. Tomes (Uunthorpe, Yorks); 9st. 7lb. M. Clark (Southwark); 10st., S. D. Charlesworth (Southwark); 10st 7lb., R. G. Hawkins (Finchley); 11st., E. P. Earwaker (Ipswich).

Seniors. — 8st., E. Collins (Southwark); 8st. 6lb., H. Dixon (Huddersfield); 9st., W. Thom (Birkenhead); 9st. 9lb., S. Davis (Southwark); 10st. 7lb., S. J. Lewis (Potters Bar); 11st. 6lb., A. Watkinson (Doncaster); 12st 7lb., F. Bell (Barnoldswick); Heavyweight, R. Round (Brighton).

The Stromberg Carburettor

by a Naval Engineer Officer

Many readers have asked us for details of the Stromberg carburettor. An expert here describes it.

THE Stromberg carburettor is coming into use in increasing quantities in the modern aircraft of the Fleet Air Arm. Its outstanding feature, contrasted with British types, is that the fuel is not drawn into the airstream by the suction of the engine, but is forced in under pressure through an atomising or spray nozzle. The fuel is under pressure in a closed system from the fuel pump to the spray nozzle, the pressure at the discharge of the former being 15 lb. per square inch, and at the latter 4-5 lb. per square inch is necessary to open the spring-controlled valve. Between the two is the regulating mechanism for controlling the fuel flow.

Metering

The primary function of any carburettor is to meter the fuel in proportion to the weight of the air passing to the engine. This metering can be done either by varying the pressure which forces the fuel through the metering orifice, or by maintaining the pressure constant and varying the size of the orifice. Both these methods are employed in the Stromberg carburettor; the first to meet the variations in the weight of air passing to the engine, and the second to give rich or weak mixtures as required for different conditions of flight.

Air Measuring

Figures 2 and 3, which are reproduced by kind permission of Bendix Aviation Corporation, of South Bend, Indiana, U.S.A., give diagrams of the Stromberg carburettor. For the sake of clearness the air section and the fuel section of the regulator unit are shown separately, although in the carburettor itself they are joined in one unit (see Fig. 1). Between the air scoop and the throttle a venturi is seen. It consists of a restriction in the air passage, shaped so that turbulence in the airflow will be negligible. Its object is to measure the airflow, for the greater the airflow through it the greater the drop of pressure or suction in the narrowest part, usually known as the throat. The boost venturi has its discharge in the throat of the main venturi, hence the suction in its throat will be greater still. It steps up the effect of the main venturi.

One side of the air diaphragm in the regulator unit is connected by a passage to the throat of the boost venturi. The other side of this diaphragm is connected to the inlet air by a passage which passes the automatic mixture control unit. A small bleed passage connecting the two sides of the diaphragm ensures a flow of air past the automatic mixture control unit. The difference of pressure acting on the air diaphragm creates a force known as the air metering force, which opens the fuel poppet valve.

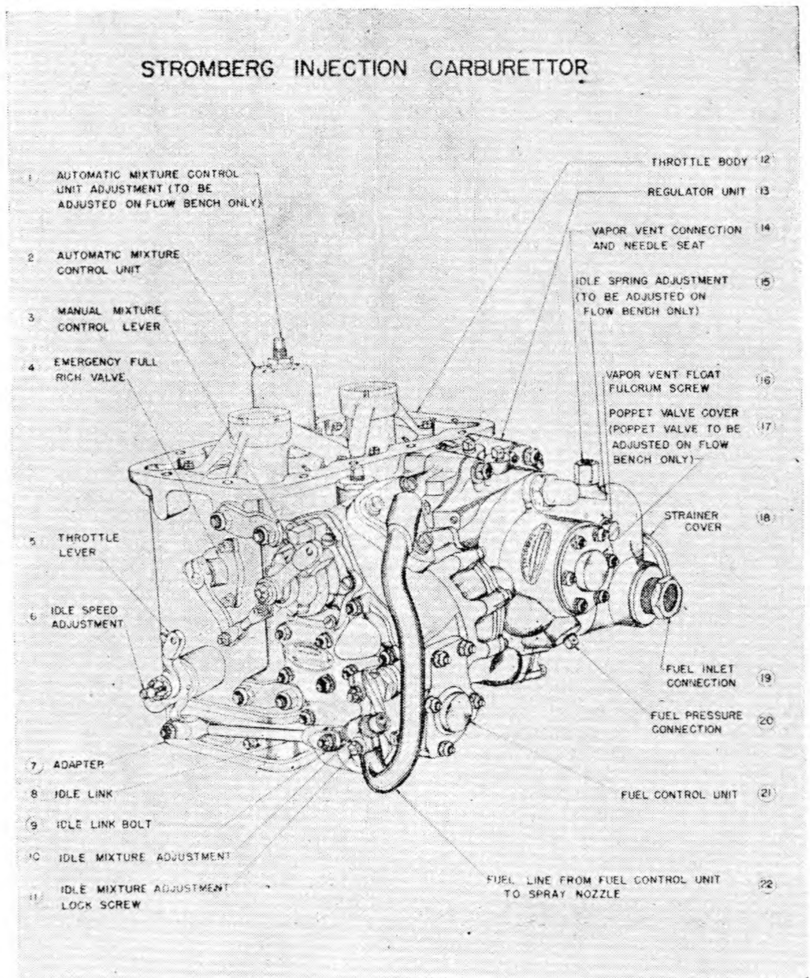
Fuel Measuring

The fuel pump delivers fuel through a fuel strainer, past the poppet valve, into chamber "D" of the fuel section of the regulator unit. From chamber "D" it flows through the metering nozzles to chamber "C," which is connected to the spray-nozzle unit. Any difference of fuel pressure between chambers "D" and "C" has two effects. Firstly, it exerts a force on the diaphragm in the fuel section of the regulator unit, and, secondly, it causes fuel to flow from chamber "D" to chamber "C." The air diaphragm and the fuel diaphragm are the same size. From this it follows that equilibrium will be reached when the fuel metering force is applied to the air metering force. If the air metering force is greater it will open the fuel poppet valve and admit more fuel to chamber "D," while if the fuel metering force is greater the reverse will happen. It has been seen above that the air metering force is a measure of the airflow, so it is clear that the fuel metering force must be similar.

Mixture Requirements

In the *A.T.C. Gazette* of April 1944 the different mixtures required under various conditions of performance were considered, and the following is a summary of the requirements:

Fig. 1.



(*a*) A slightly rich mixture when the engine is slow-running.

(*b*) A weak mixture at cruising speeds for economy of fuel.

(*c*) An increasing rich mixture under overload conditions.

The Stromberg carburettor provides for these variations by varying the size of the metering jet.

Slow Speeds

When the engine is only ticking over there is not enough force on the air diaphragm to open the poppet valve. For these slow speeds it is held slightly open by means of a spring, known as the idle spring. This opening will pass enough fuel for a fast tickover. For slower speeds the fuel supply is controlled by the idle needle valve, which reduces the size of the metering jet between chambers "C" and "D."

Other Speeds

When the throttle is about 10 per cent open the idle needle valve is drawn out to its open position and the metering shifts to the cruising jet. The opening of this jet is controlled by a manual mixture control lever. This lever has four positions—idle cut-off, auto-lean, auto-rich and full-rich. In the idle-cut-off position a disc valve completely closes the cruise jet, and no fuel can pass from "D" to "C." In the auto-lean position the control needle is not altogether clear of the cruise jet, whose effective area is thereby slightly reduced. In the auto-rich and full-rich positions the jet is fully open, and the metering follows the difference in fuel pressure.

In some patterns of this carburettor the arrangement may be slightly different. Separate metering jets are fitted for auto-lean and auto-rich, and the fuel is directed to one or other by a cut-away disc valve.

When the power range is reached the power enrichment valve begins to open. At lower powers it is held on its seat by a spring against the opening force of a diaphragm disc, subject to the fuel pressures of chambers "D" and "C." When the power range is reached the difference of pressure is enough to overcome the spring, and any further increase in the fuel metering force will open the valve The opening of this valve gives an additional orifice between chambers "D" and "C," so that fuel, additional to that which passes through the cruise jet, can flow from "D" to "C." Maximum enrichment is obtained when the area of these two orifices equals the area of the master take-off jet, for then the metering automatically transfers to the latter.

Requirements Fulfilled

By these means the main requirements of an aircraft carburettor are met. The article already referred to also showed the following requirements to be essential:

(*a*) A correct mixture must be maintained automatically at all altitudes.

(*b*) A correct mixture must be maintained while the throttle is being advanced.

(*c*) A carburettor must continue to work smoothly during aerobatics.

(*d*) It must operate correctly in icing conditions of flight.

The automatic mixture control unit shown in Fig. 2 consists of a bellows filled with nitrogen and an inert oil. It controls a valve in the air passage between the air scoop and chamber "A." As the aircraft ascends and the air pressure drops, the bellows expand, and the valve partially closes, thereby reducing the air metering force which tends to open the poppet valve. The inert oil acts as a damper and prevents surging.

The correct mixture is maintained during acceleration by a diaphragm pump. One side of the diaphragm is connected to the passage between chamber "C" of the regulator unit and the spray nozzle. The other is connected to the engine side of the throttle, where there is a suction at slow speed. When the throttle is suddenly opened the suction decreases, and the diaphragm returning to its normal position causes a temporary increase in the fuel discharged into the main airflow.

Since the carburettor has no movable parts it is not susceptible to the influences of "g" or negative "g" arising during aerobatics. Finally, the spray unit nozzle can be arranged in any part of the air line, e.g. to spray into the eye of the supercharger; consequently the formation of ice due to vapourisation of the fuel is greatly minimised. From this brief outline it is seen that the Stromberg injection carburettor adequately fulfils all the requirements of an aircraft carburettor.

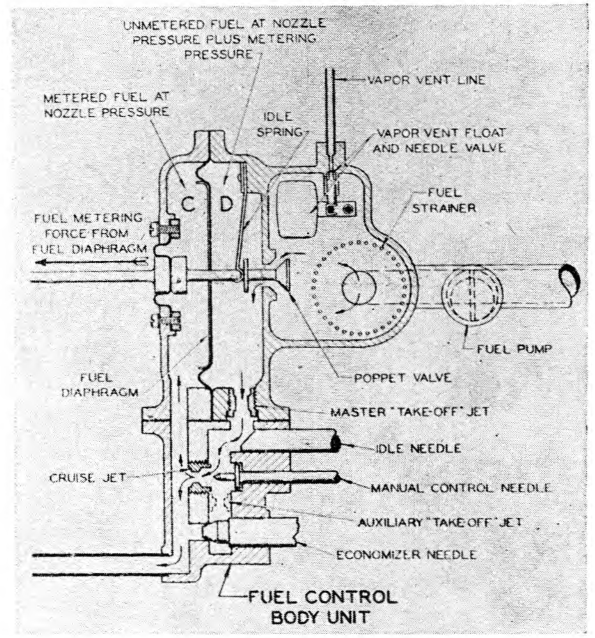


Fig. 2.

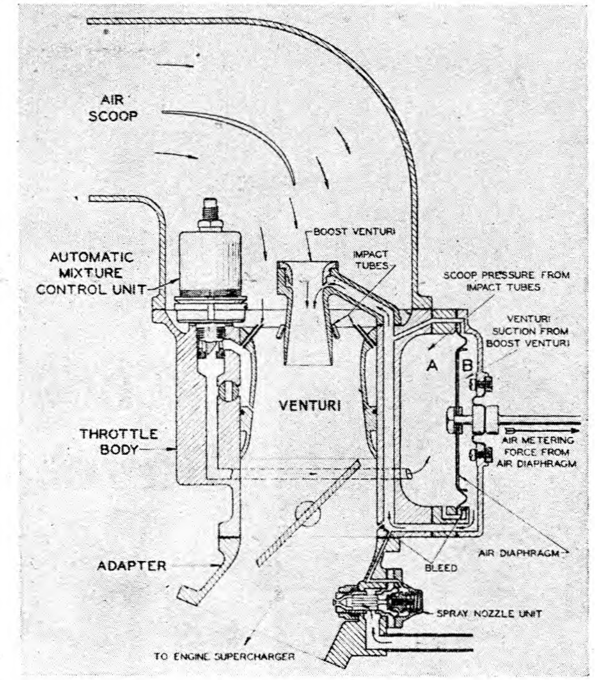
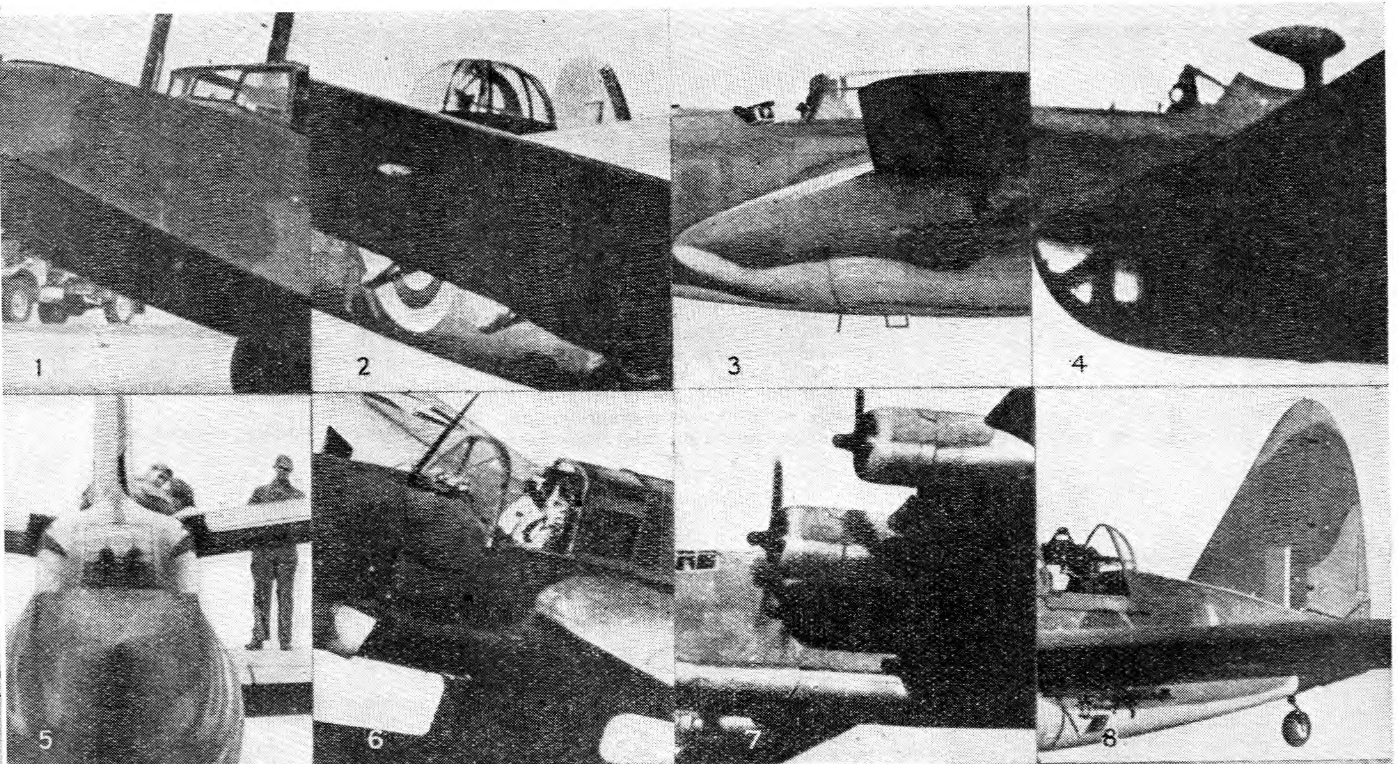
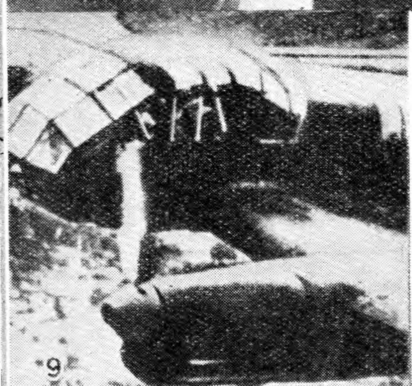


Fig. 3.

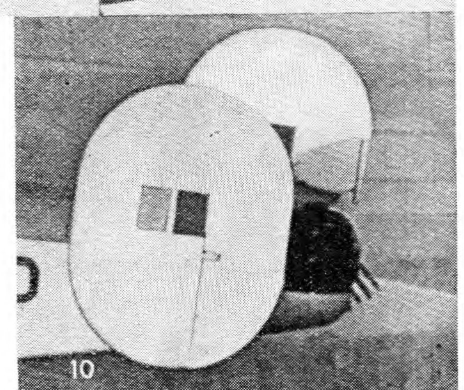


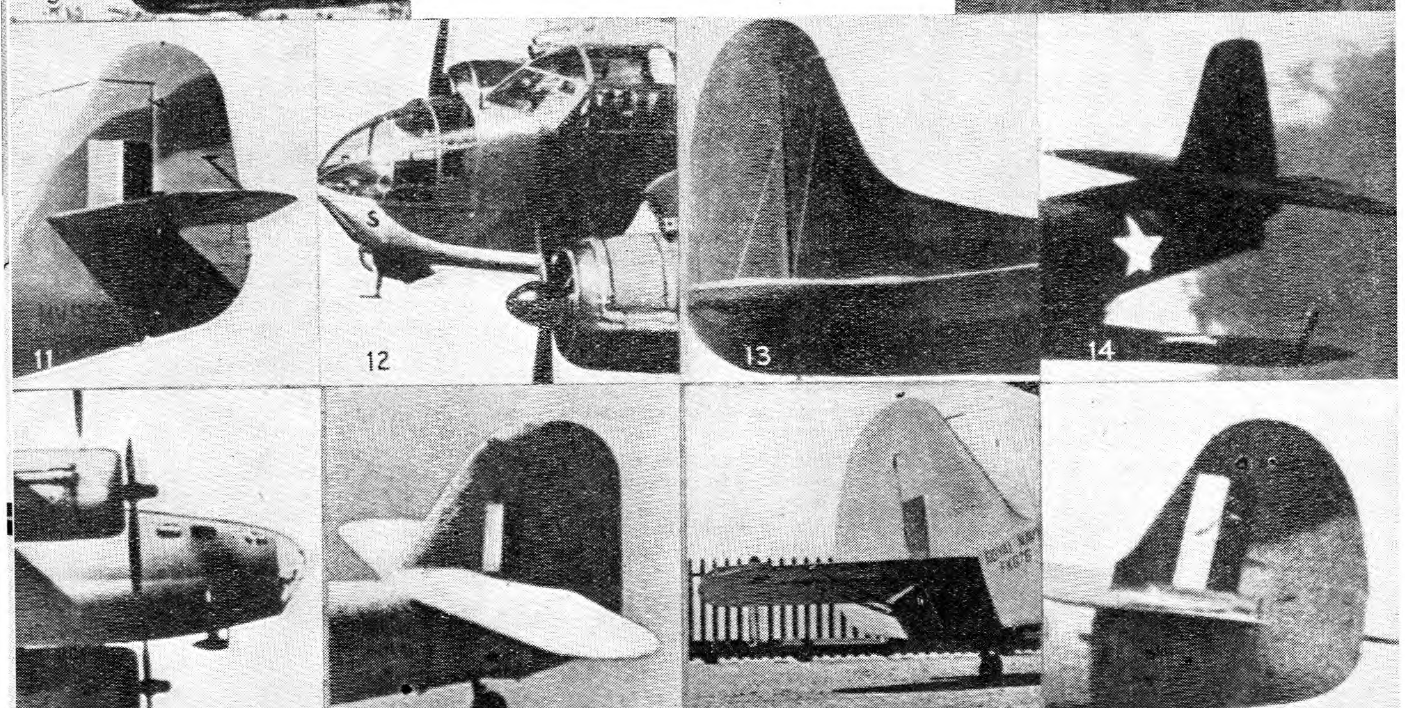


These You Have Noticed

(Perhaps)

If not, turn to page 24.





STANDARDISE THE STICK

by Captain Norman Macmillan, M.C., A.F.C.

EVERY good pilot possessed of reasonable flying experience can pilot any type of aeroplane. But before he can take into the air an aeroplane to which he is unaccustomed he must study the peculiarities of several features which vary between one aircraft and another, even in the same class. (This does not mean that a Martlet pilot can step into a Sunderland and take the flying-boat off the water without difficulty. There are tricks in every trade, and the trade of the seaplane pilot is distinctive from that of the landplane pilot, because of the marine element which the former must understand. But there is no reason why any pilot cannot manipulate a flying-boat in the air.)

Gadgets

If all aircraft controls were fully standardised it would be much easier to change from one aircraft to another. But there is a great absence of standardisation in many respects. One aircraft may have the flap control on the cabin roof, another one has it on the instrument board, yet another mounts it on the side of the cockpit. The reason is that the aircraft are designed first as airframes and the controls are put in afterwards, and often they are put not where the pilot can most easily find them quickly, but quite candidly in the place that most suits the harassed designer or production engineer who has got to find a place for the manifold gadgets that a modern aeroplane must possess. Of course, it is easier to put the flap control of a high-wing monoplane on the inside of the roof and that of a low-wing job on the floor, but this easy get-out for the designer and constructor means that in emergency the pilot may have to grope all round the cockpit to find the flap control when his motive power fails in a fog and he has got to get down into the smallest of allotments in a London suburb. It's all right if the pilot is flying the same kite every day. Then it is second nature to put out a hand correctly every time to the desired control. But if he is ferrying, or testing, or up for the first time in a strange machine he may spend a precious few moments pulling or pushing the wrong knobs before his fingers find the one he wants—for in emergency it is often impossible to look inside the cockpit to see the control layout, because eyes must be kept focused on what lies beyond the windscreen.

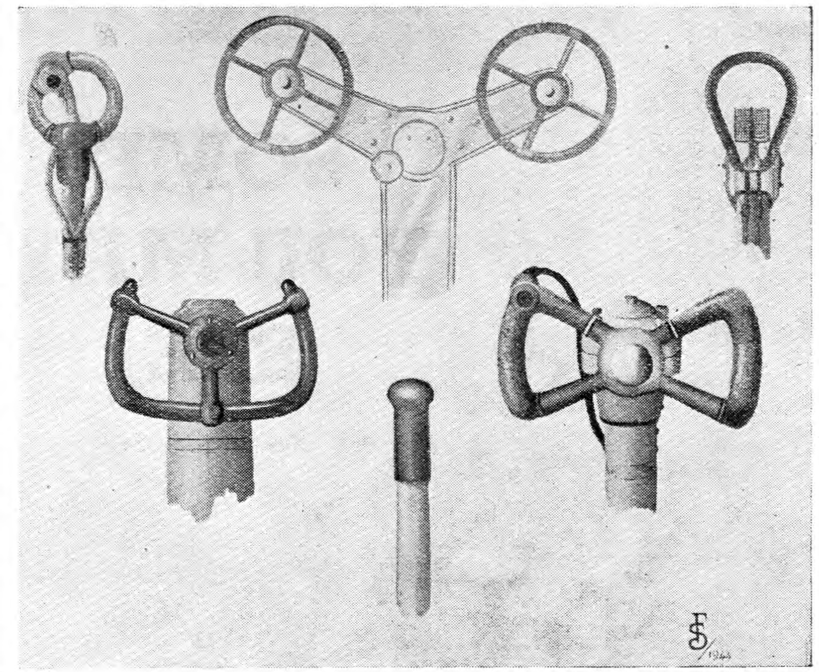
Where the Control Came From

But there are things which could be standardised without difficulty and are not yet standardised. The standardisation of the blind-flying panel was not achieved without a struggle. Before that there was some attempt to place the three principal flying instruments—the airspeed indicator, tachometer and altimeter—in a standard arrangement, but it did not reach standardisation.

In the early days of flying there was no standardisation in air controls. One designer used two sticks, another two wheels, and others various ways of operating the rudder, elevator, ailerons or warping wings. Robert Esnaulte Pelterie designed and patented the universally mounted stick to control ailerons and elevator and footbar for rudder. The British Government paid for the British rights in Pelterie's patents, for nearly every British aircraft of the Great War used them, and that war in the air was fought on the Pelterie principle of control. Today it is so accepted that it seems unthinkable that there ever was any other proposal for the disposition of the pilot's main controls.

Yet we have still not learned what we should have learned about standardisation. In the simple matter of the aileron and elevator control we have a whole gallery of varying designs. Many American aircraft use a simple straight stick, like the handle of a cricket bat. Most British aircraft of the smaller varieties use the circular handgrip. But there are exceptions. Some quite small aircraft have tiny handwheels for aileron control. There are aircraft with curiously distorted segments of handwheels. Some with cranked columns, others that hinge laterally. It almost seems as though this most important control in the pilot's cockpit is treated as one way of getting over some other difficulty—bending it to one side or the other, cranking it, mounting it with a broken wheel, fitting it to a vertical column or a horizontal tube that slides in and out of the instrument board.

Of course, a pilot will fly any type of aircraft, no matter what the designer, the test pilot and the conference experts do to it. But it would make the flying life of a pilot a good deal more comfortable if more thought could be given by the prototype specialists to standardisation. The ordinary pilot would not have to get accustomed to a different handgrip with almost every change of aircraft, and it would save him from a lot of time spent memorising where the gadgets are in his new mount. Training for flying is already a complicated process. Standardisation, wherever possible, would ease the journey from the A.T.C. to the operational unit.



A few varieties of control columns.

Choosing the Right Man

We have had many enquiries about the new system of selecting and classifying aircrews. We passed these on to the right places, and have received as a result this very lucid, informative and authoritative statement of the new arrangements.

THE selection and early training of aircrew during the first few years of the war had, at that time, many unavoidable disadvantages. Very roughly, candidates were accepted by a selection board for training in each separate category, and thereafter were retained unless they failed to reach a satisfactory standard at one of the successive stages of training. It must be remembered that there were fewer categories of aircrew: the air bomber and flight engineer did not exist, and air gunners and wireless-operator/air-gunners usually went straight to their specialist courses. The initial training wings were almost entirely concerned with pilots and observers, or, as we now know them, navigators. It is clear that all pilots had to reach certain minimum standards, or else be eliminated, but it is also clear that not all possible pilot material was given a chance to train as such. Selection by interview is not necessarily a sound method; in fact, all the available evidence indicates that such a method is little more reliable than picking names out of a hat for the purpose of selecting the best and most teachable pilots, although, of course, it may be satisfactory for selecting good officers and N.C.O.s.

The system had other disadvantages. It was extravagant in time and in money, for a cadet might not be rejected until after, say, 60 hours' flying, which would be almost a total loss to the war effort. Finally, it was sometimes bad for morale: the cadet who failed as a pilot naturally suffered from a feeling of inferiority, and if he was passed back into the organisation for training, say, as an observer, he tended to regard himself and his fellows as persons of less value and importance than the pilots.

The First Big Change: P.N.B.

In 1942 all this was changed, as the result of much patient study, experiment and thought, by the introduction of the P.N.B. scheme. By now the fact that second pilots were no longer needed by Bomber Command, coupled with the shipping problem caused by the transfer of flying schools overseas, had made it vitally important to select the best possible pilots, and new methods of doing so had been developed. Under the "grading" scheme, which is still the central feature of pilot selection in the United Kingdom, cadets, in the triple category of "pilot-navigator-air-bomber," were given 12 hours' flying, and those who were to become pilots were chosen on the basis of their performance in the air and the current needs of the R.A.F. The source of supply for pilots was thus considerably enlarged, and the subsequent classification of navigators and air bombers gave a much better chance of choosing the right man for each job.

The Next Big Change

The emergence of the six basic categories of aircrew—air bomber, air gunner, flight engineer, navigator, pilot, and wireless operator (air)—and the increasing need to conserve manpower, have made it necessary to make further changes. So in April 1944 a new system was introduced whereby all accepted aircrew volunteers do a period of common training at the onset of their career in order to emphasise the fact that they have a common goal, are classified on the basis of ability by undergoing certain tests (including grading for those with high pilot-prediction), and are then trained separately in initial training wings according to their classification. Most of the disadvantages of earlier schemes have been overcome by this means; its main advantage is that all volunteers for aircrew duties are available for allotment among the six categories in the best way possible.

The Scheme as it is Today

In broad outline the scheme works as follows: Cadets are accepted for aircrew training by the *Aviation Candidates Selection Board.* The Board recommends them for a particular category, but it is made clear that this "shadow" classification is only provisional, and will be modified by other factors at a later stage; the main task of the Board is to decide whether a candidate has the keenness, the courage, the character, the temperamental and other qualities which are required in any category of aircrew.

Cadets are called up for training to an *Aircrew Receiving Centre,* are kitted, medically examined, inoculated and vaccinated, spend six weeks in general service training, and are given a series of aircrew aptitude tests. By these tests an assessment can be made of many qualities, including intelligence, powers of reasoning, mechanical comprehension, manual dexterity and reaction time.

It is neither necessary nor desirable that the cadet should have advance information about the details of these tests, but he should understand that they are used to measure the particular aptitudes which are required for successful training in each category, and that they have been found to have an excellent predictive value for this purpose. It is also important for him to realise that their results cannot be guessed from their outward appearance; for example, the test of turret manipulation appears to be a measure of aptitude for air-gunner training, but in fact measures a type of co-ordination which is also important in pilot training.

After the tests, a fair block of cadets in each entry that has been tested then passes to the "specialist" I.T.W.s for all aircrew categories except pilot. The candidates for pilot I.T.W.s have still to go through one more testing and selection stage.

The final basis for pilot selection is still the system of grading. The most promising pilot material is sent to *Grading Schools,* after due account has been taken of such limiting factors as age, medical fitness and personal preference, and each cadet is given 12 hours' flying. The results of two flying tests enable a selection to be made of the most promising cadets, and the remainder are allotted among the other categories according to their aptitude.

There are three main factors which are considered in classifying aircrew—the current needs of the R.A.F., the demonstrated aptitude of each cadet, and his personal preference. The relative importance of these factors is a matter of common sense. If the R.A.F. requires a certain number of air bombers and a certain number of flight engineers, that requirement overrules everything else. Aptitude for a particular category is next in importance; and, finally, if there are two men of equal abilities available to fill one air bomber and one flight engineer vacancy, then they will be classified according to their wishes.

Under the new scheme cadets go forward after classification to one of six distinct types of *Initial Training Wing.* This enables each category of aircrew to concentrate early on the subjects of greatest importance to him and to avoid any training which is applicable to only one or two categories out of the six. The course lasts eight weeks for air bombers, navigators and pilots, and six weeks for the other categories. Roughly 39 hours each week are spent in classroom or in practical work, and nine hours in drill, physical training and games.

The career in the R.A.F. of A.T.C. cadets who hold the Proficiency Certificate, and who have reached a high standard during their "post-proficiency training," follows closely the lines for other direct-entry cadets. Thus they pass through A.C.R.C. in the normal way, are classified according to Service needs, aptitude and personal preference, and are posted to an I.T.W. They have, however, the advantage of considerable knowledge of the subjects taught, and are given the option of accelerating their training by taking the examinations after only four weeks of instruction.

The R.A.F. and the Empire

The R.A.F. is a true child of the British Commonwealth. Before the war young men from the Dominions and Colonies came over to serve for a period with the R.A.F. and return to their own country.

They were picked men, and they made friends wherever they went. They helped to spread a knowledge that cannot be too great among people at home for the Dominions and Colonies.

The R.A.F. was a real bond and training school of Empire.

Since the start of the war this process has been tremendously developed and accelerated, and the Empire Training Scheme has been of a very special value.

Today there are personnel of five Dominions and India, and 25 Colonies in and with the R.A.F., serving side by side not only in the same units, but more than that, they are serving as a mixed aircrew in the same aircraft.

Many aircrews today contain members from three or four parts of the Empire, and one or two have a many even as five.

There were many young men from the United States who came to join us as volunteers before their country came into this war. Rightlv they have now joined American units, but they will remain, I know, for I have spoken to some of them, as proud to have served in an aircrew of the R.A.F. as we were glad to welcome them.

And we have also with us the Air Forces of eight European Allies. That is a big thing. The common bonds of friendships thus formed, the habit of working together for freedom, may stand us well in the years of reconstruction to come.

All these diverse elements from all over the world—and let us remember that men have come from the farthest corners of the earth to serve with the R.A.F., and from foreign nations speaking other languages than ours nearer home—all are treated alike. The R.A.F. has absorbed them all and made of them one coherent Fighting Force.

—Air Marshal Sir R. H. Peck, K.C.B., O.B.E., *Assistant Chief of the Air Staff.*

Some You May See

SEE PAGE 22

1, Marauder; 2, Bristol Blenheim I; 3, Boeing Fortress 2s; 4, Brewster Buffaloes; 5, Bristol Beaufighter; 6, North American Harvard I; 7, Me 109E; 8, North American Mustang; 9, Short Stirling; 10, De Havilland Mosquito; 11, Fairey Gordon; 12, Vickers Supermarine Walrus; 13, North American Mitchell; 14, Hawker Hurricane IID (Tank-buster); 15, Grumman Avengers; 16, Consolidated Liberator; 17, Westland Whirlwind; 18, Bristol Beaufort; 19, Douglas Boston III; 20, Curtiss Tomahawk; 21, Grumman Wildcat; 22, Waco C.G.-4 (Hadrian); 23, Martin Baltimore; 24, Sikorsky Helicopter R4; 25, Wacket Wirraway; 26, Lockheed Lightning; 27, Short Sunderland; 28, Breda 88; 29, Blackburn Skua; 30, Junkers Ju 87 (Stuka).

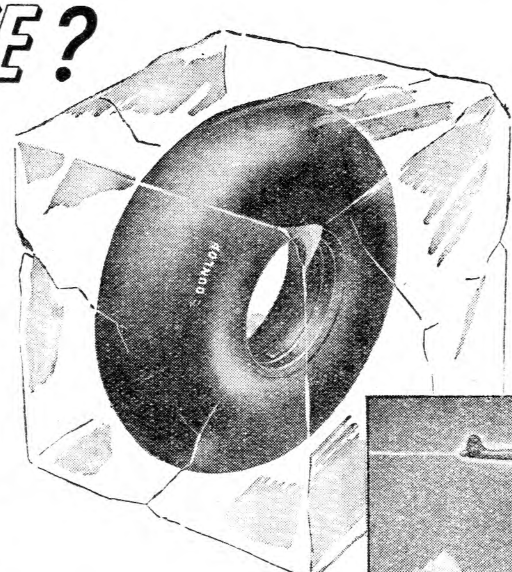
(In May's test, "You should know them," No. 21 was a Piper L-4b, not Taylorcraft as stated. Did you spot it?)

These You Have Noticed

SEE PAGE 20

1, Supermarine Walrus; 2, Lockheed Hudson; 3, Douglas Boston; 4, Handley Page Hampden; 5, Martin Marauder; 6, Curtiss Seagull; 7, Consolidated Liberator; 8, Brewster Bermuda; 9, F.W. 189; 10, Consolidated Liberator; 11, Grumman Goose; 12, Bristol Beaufort; 13, Waco C.G.-4a (Hadrian) Glider; 14, Grumman Avenger; 15, Fortress II; 16, Fairey Albacore; 17, Stinson Reliant; 18, Bell Airacobra.

What happens when tyres FREEZE?



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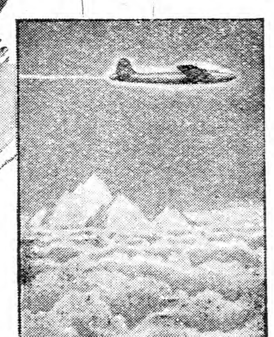

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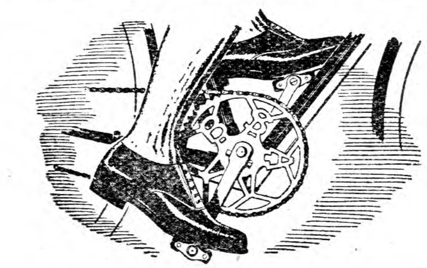

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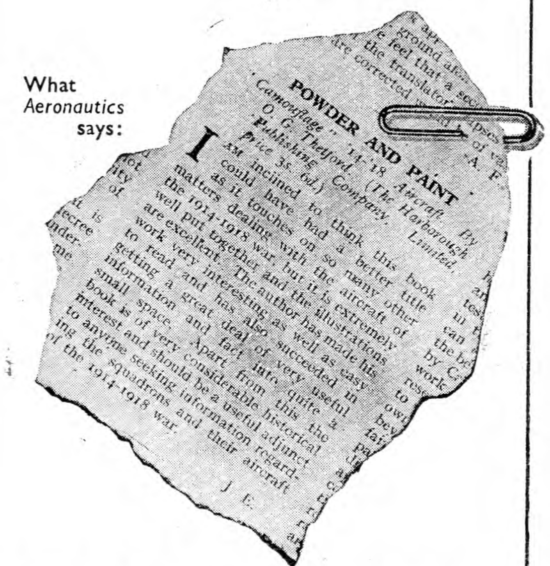

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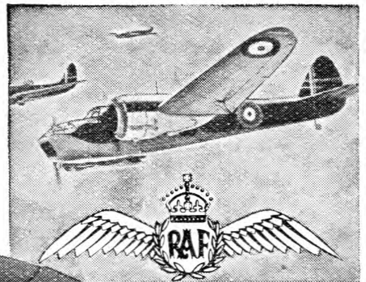

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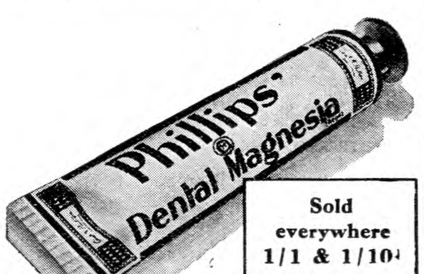

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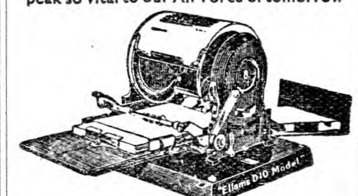

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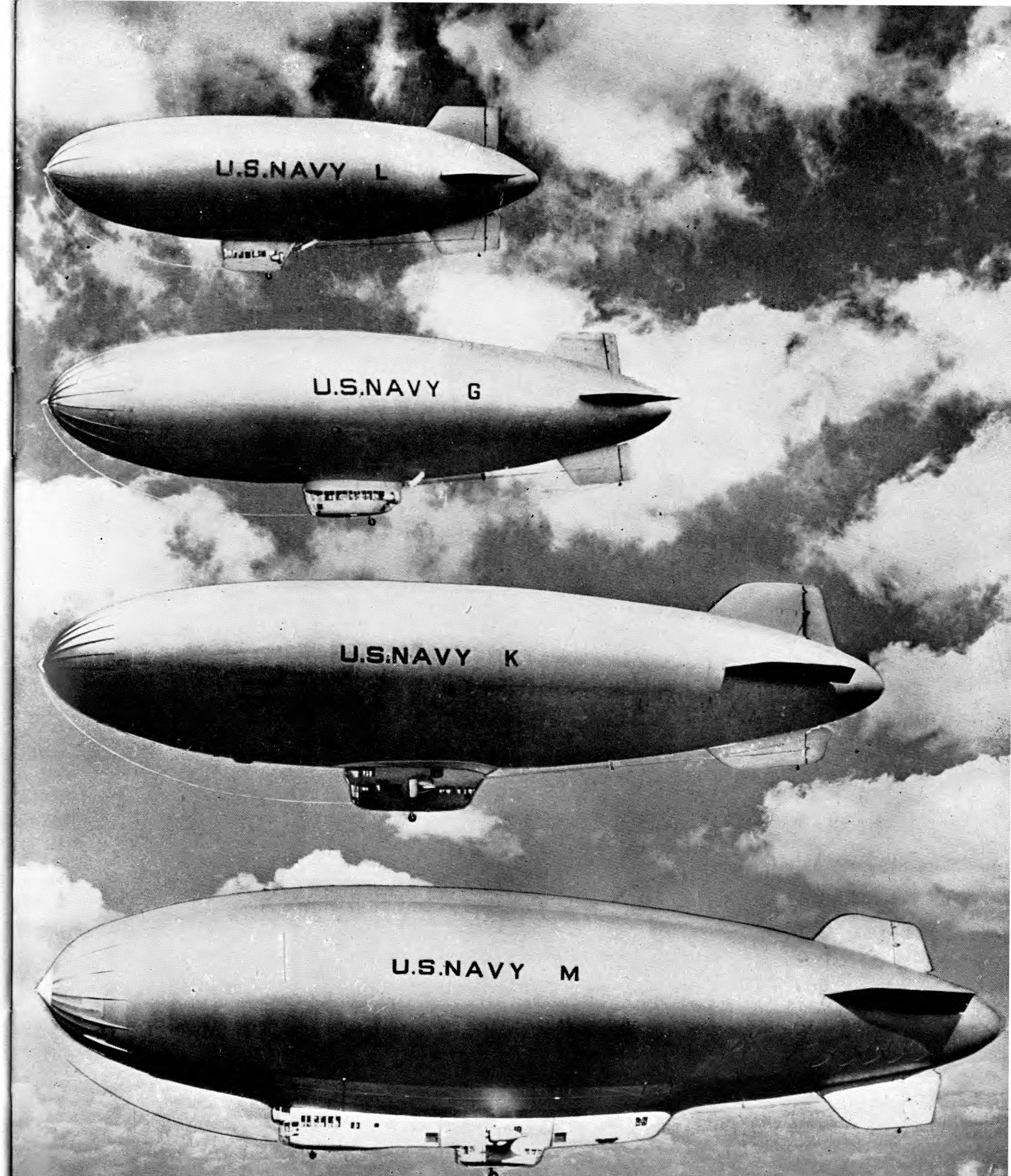
Published for the Proprietors, The Air League of the British Empire, Kinnaird House, 1a Pall Mall East, London, S.W.1, by the Rolls House Publishing Co., Ltd., Rolls House, Breams Buildings, London, E.C.4, and printed by the Stanhope Press Ltd., Rochester, Kent.



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