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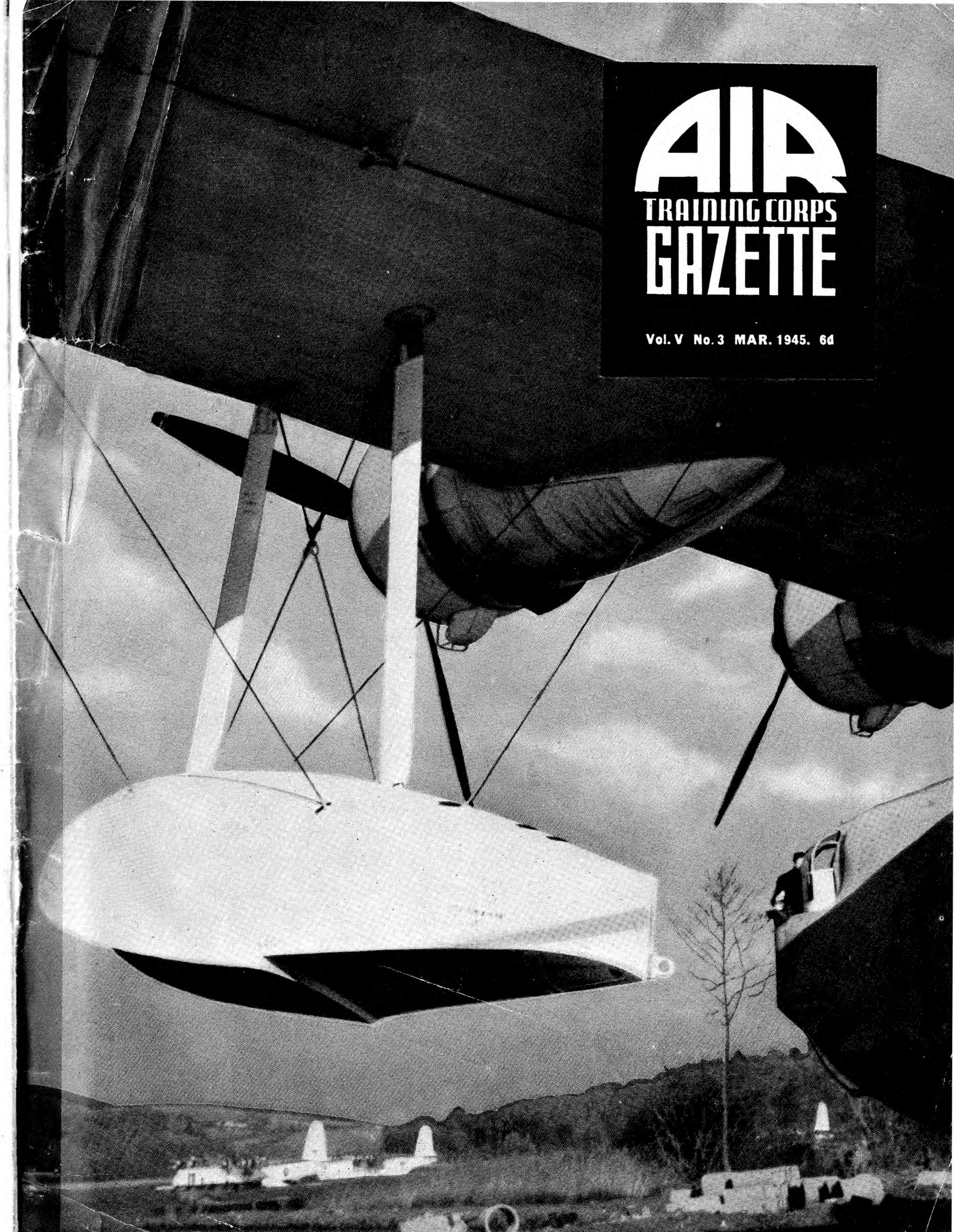

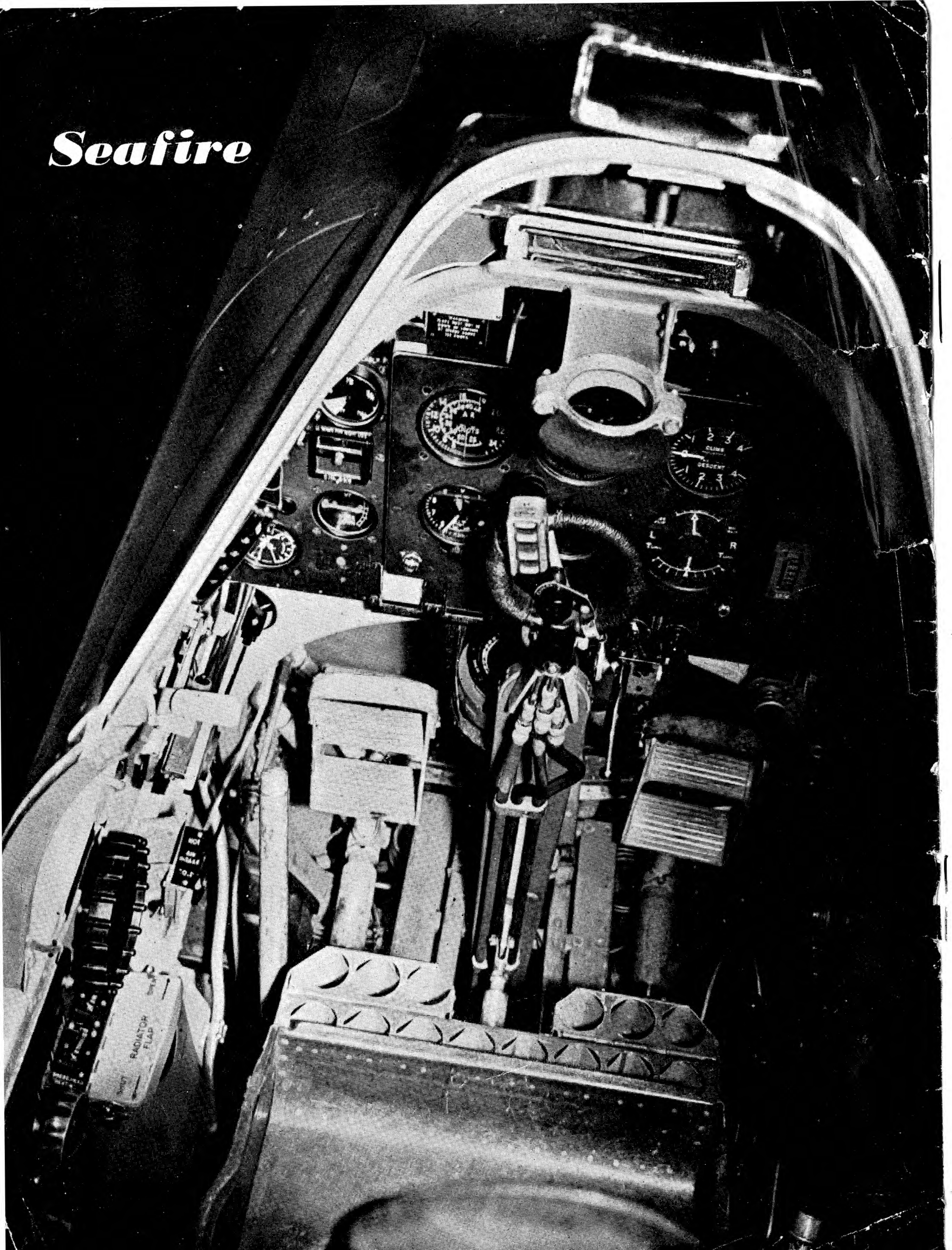

AIR Training Corps GAZETTE

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After Victory—What?

VICTORY in the West now looms unmistakably clear. It may even be that before these words are in print the rushing development of events, making history before our eyes, will have turned future prospects into unexpected reality. But we cannot count on that. As has happened before in this long and bloody struggle, the final attainment of victory may elude us for a while.

But even though the end of the war in Europe should be deferred, it will only be for a while. We can now discern the inevitable end of German resistance. And so it is not only opportune but necessary to pose the question: After victory, what?

I will not attempt any prophecy, and especially about the other half of the war, that against the Japanese. But it may be assumed that not a great proportion of cadets now in the Corps will have time to finish their A.T.C. training and get through the R.A.F. schools in time to take much part in the actual fighting. For most cadets it is the interim unsettled period after hostilities, and the real post-war period to follow, which will matter.

The function of the Air Training Corps in the post-war era has been defined as "a main source of supply of recruits for civil and military aeronautics." We have just had an assurance from the Chief of the Air Staff that "the time will come when the R.A.F. will again welcome every fit young man the Corps can train"; adding that the A.T.C. is firmly established as an integral part of Royal Air Force training organisation.

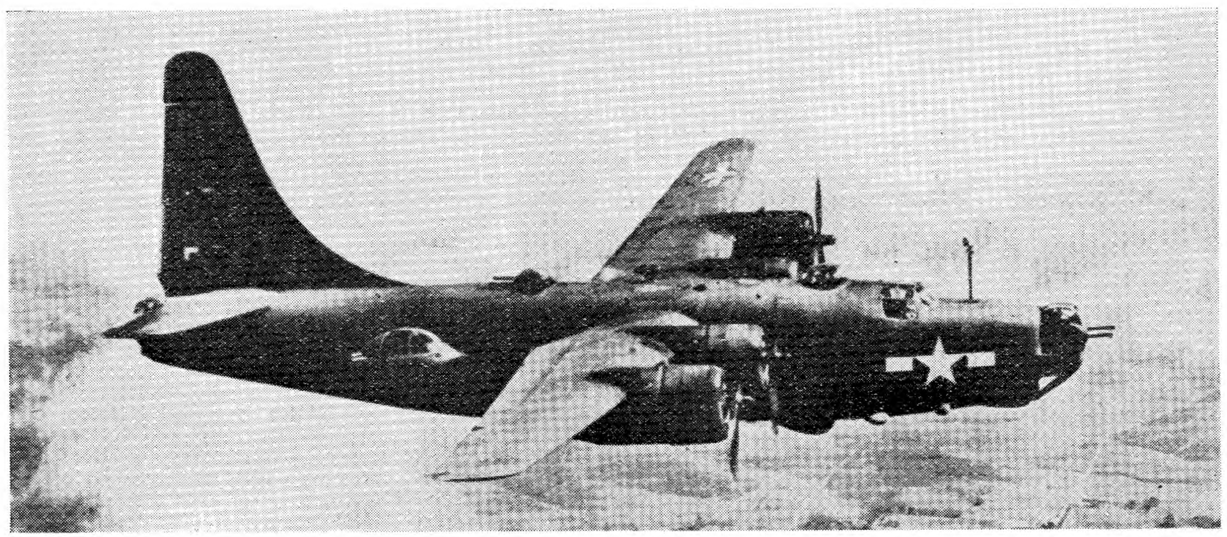
That is our charter. It means that the younger members of the Corps, at any rate, and new recruits will have a solid prospect of service with the regular Air Force or with the Air Force Reserves.

I hope that in a forthcoming issue it may be possible to give in some detail an authoritative statement of the future needs of the Royal Air Force and the way in which the A.T.C. will fit into that picture. For the present I will only say that when victory does come—secured, let us not forget, largely by the heroism and sacrifice of those who have fought in the air—our own task is not done.

After victory we shall have work to do if the security and prosperity of our land is to be maintained. Let that be our purpose, and our pride.

E. L. GOSSAGE, AIR MARSHAL,
Chief Commandant and Director General, Air Training Corps.

The Consolidated Vultee PB4Y-2 Privateer.



Captain Norman Macmillan, M.C., A.F.C. says—

TEST YOUR COLOUR VISION *early*

EYESIGHT is the basis of all pilotage, and prospective and present aircrews cannot be too particular about the care of their eyes.

Some pilots have better night vision than others, because the part of their eye structure which functions in poor light happens to be more sensitive. Some pilots have exceptionally good sight over long distances. It was remarked during the Battle of Britain how high was the standard of long-range eyesight of the Polish pilots who flew in No. 303 Squadron; they appeared to have a facility to recognise aircraft when but little more than specks in the sky.

Colour vision is a strict requirement for aircrew duty, not because its possession in a specially sensitive degree necessarily makes a better pilot, navigator, or air gunner, but because colour vision is essential for recognition of the navigation lights of other aircraft and for other standard duties in airmanship.

There are three categories of colour vision — "Normal," "Defective but Safe," and "Defective and Dangerous." The normal person will never make a mistake in distinguishing between most if not all of the primary colours. The defective but safe colour vision subject may be trichromate or better, and the defective and dangerous may be entirely colour blind or so erratic as to vary his perception of colour vision if one colour is preceded by a variety of other colours or altered shades of colour.

As I have already said, defective colour vision does not necessarily make one a bad pilot. Indeed, it may be quite otherwise. The late F. D. Bradbrooke, who was killed in a crash when travelling as a passenger in an aircraft that was taking off from Britain to cross the Atlantic, was colour vision defective. Before the war he had a pilot's A licence, and could not get a B category licence because of his colour vision defect. And I think his A licence had some restrictions, such as no night flying. Yet "Brad" was an exceptionally good pilot, and after the war began he rose and rose in the flying career after joining Air Transport Auxiliary (in the formation of which he had played a part) until he became the pilot of aircraft flying the Atlantic from Canada to Britain. It was after emplaning to go across to fetch another aircraft that he was killed. So there was the strange case of a pilot who could not be a R.A.F. pilot, or get a B licence, flying the very same aircraft as those with perfect colour vision and flying them over the world's worst air route when it was not so well organised as it now is.

> **Colour vision is a thing with which people are born. You cannot improve it by training, say the specialists.**

His case reminds me of another curious case, that of the late W. G. R. Hinchcliffe who lost his life while trying to fly the north Atlantic with the late Hon. Elsie Mackay, who was also a pilot. Hinchcliffe flew in the Great War and when that war ended he wanted to go into civil aviation. But he had by then only one eye, and the British medical regulations did not approve of pilots with only one eye getting a B licence to qualify them to fly passengers and goods "for hire and reward" as the official phraseology has it, and Hinchcliffe was turned down.

He went over to Holland when the K.L.M. airline started, and I believe became a Dutch citizen. He was granted a Dutch licence and used to fly passengers, including British passengers, between Amsterdam, Rotterdam and London in a machine with Dutch registration instead of British, until he did the job for so long without an accident—and it was easier to have an accident in those days when things were not so well organised, and most passenger aircraft had only one engine—that a British licence could no longer be refused him. So he came back to Britain and flew as a British citizen with a British B licence. Which just shows that in the air it is impossible to keep a good man down.

But colour vision defective and dangerous is perhaps a greater bar than the loss of one eye, as with Hinchcliffe, or one arm, as with Maclachlan, or a couple of legs, as with Bader, because it is definitely held that colour vision is a quality with which people are born. Either you have good colour vision or you have not. And if you have not got it there seems to be nothing you can do about it. You cannot train yourself to have better colour vision say the specialists on the subject, so it is a sound plan to have one's colour vision tested early, to save disappointment later in case it is proved defective. For then the time spent training for aircrew duty could be applied to something else with greater profit.

Possibly few aspirant pilots or other members of aircrews know much about the physics of colour vision, but there is no mystery about it.

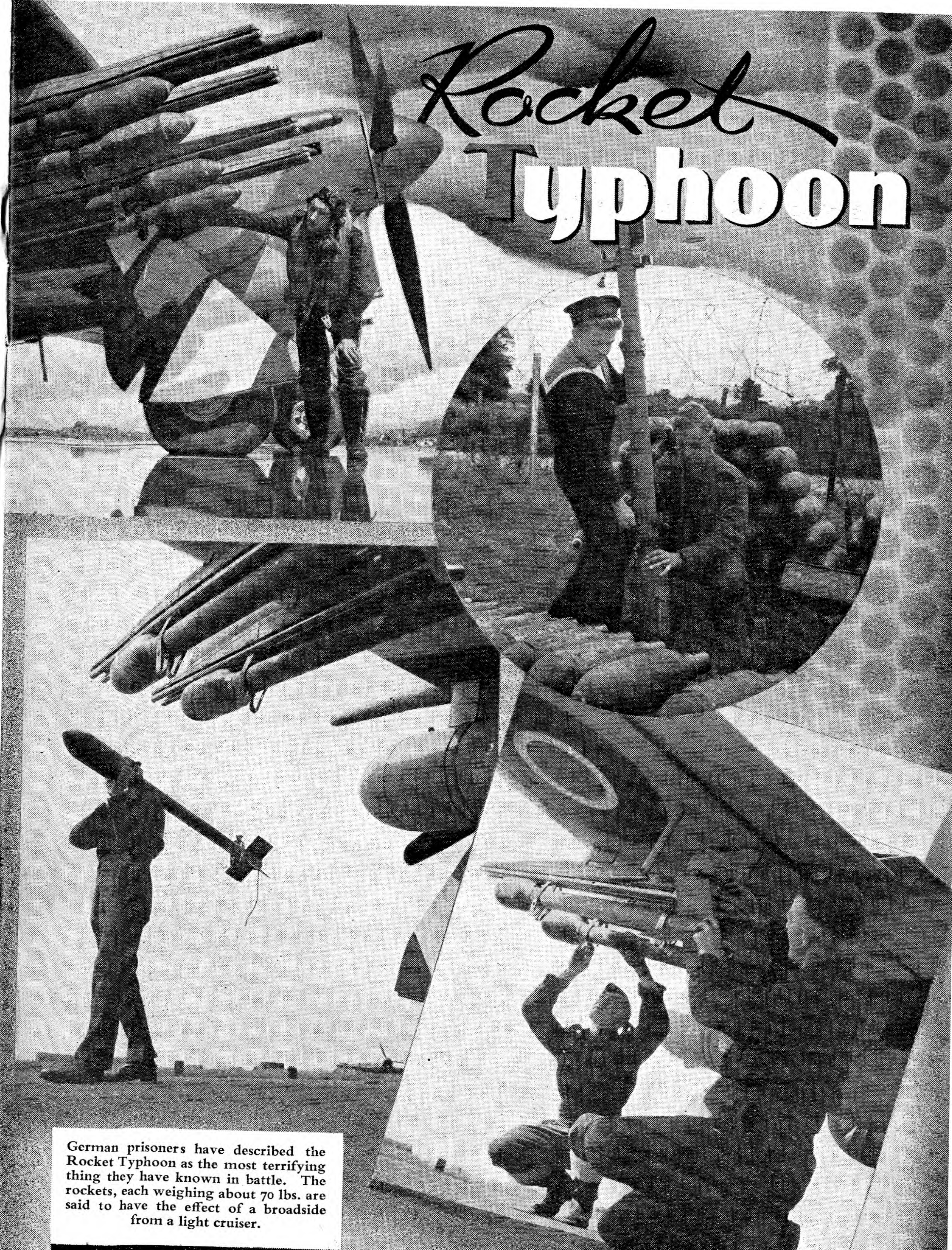
Light is commonly accepted by everyone as something definite in itself, but it is in fact produced by a very narrow waveband of rays which have on their shorter side the Ultra-Violet, X- and Y-Rays, and the Cosmic Rays, and on their longer side the Infra-Red and Hertzian Rays, the longer of the last-named being used in wireless.

The retina of the eye is an extremely delicate receptor of light radiation, sensitive to an astonishingly small amount. Colours correspond to certain bands of wavelengths, and as the wavelengths of visible light are very short, the sensitivity of the reception must be of a high order to distinguish one from another with great clarity and speed. And it is of interest to note that the human eye is most sensitive where the sun emits its maximum energy, which corresponds with the green region of the spectrum.

The wavelengths of visible light range from about 4/100,000 of a centimetre at the violet end of the spectrum to about 8/100,000 of a centimetre at the red end. So the apparatus that has to register the colours with accuracy on a waveband so fine as this must do its work with an exactitude that makes precision tools and electric micrometers appear as coarse as adzes.

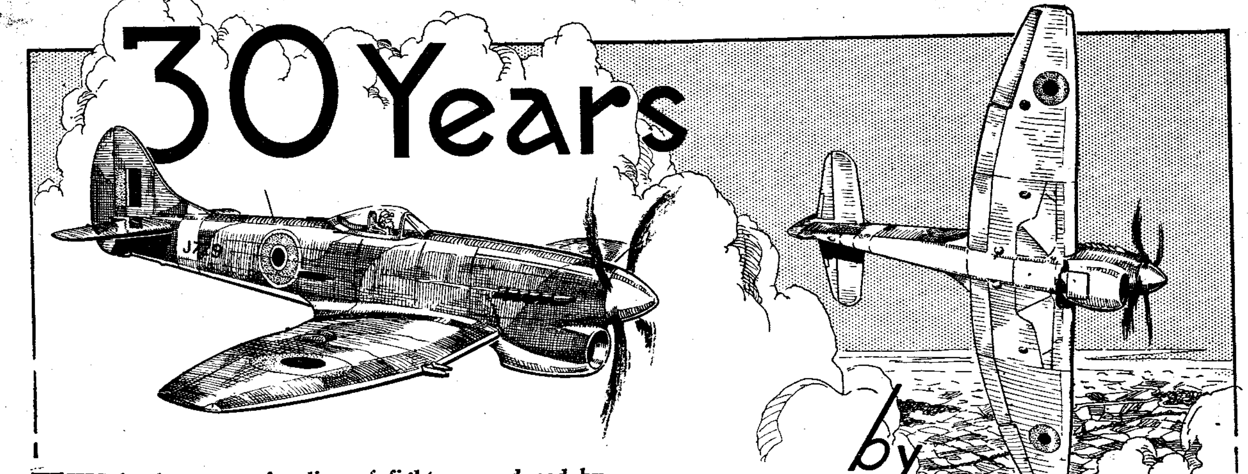
This then is the snag. If the apparatus of the eye does not register colour precisely and accurately, nothing can be done about it. You may be the finest natural pilot in the world, but if the colour vision tests set the danger signal against you, that is just that, too bad; there is only one thing to do and that is to select another branch of your chosen profession—if it is aviation—and go ahead with that side of your career without another thought of flying. And do not forget that often nature recompenses for something she withholds. Even if your colour vision is not perfect, you may have better sight for black and white, with a finer perception of shading, which may make you a first-class draughtsman and perhaps set you on the way to becoming a designer of aircraft for other men with keener colour perception to fly. And that is indeed a rarer quality than ability to fly an aircraft.

Rocket Typhoon



German prisoners have described the Rocket Typhoon as the most terrifying thing they have known in battle. The rockets, each weighing about 70 lbs. are said to have the effect of a broadside from a light cruiser.

30 Years



by JAMES HAY STEVENS

THIS is the story of a line of fighters produced by one British company, a story that gives a cross-section of the development of that type of aeroplane since the beginning of the last war. These fighters are those of the Hawker Company, and its predecessor the Sopwith Company, both firms under the direction of Mr. T. O. M. Sopwith.

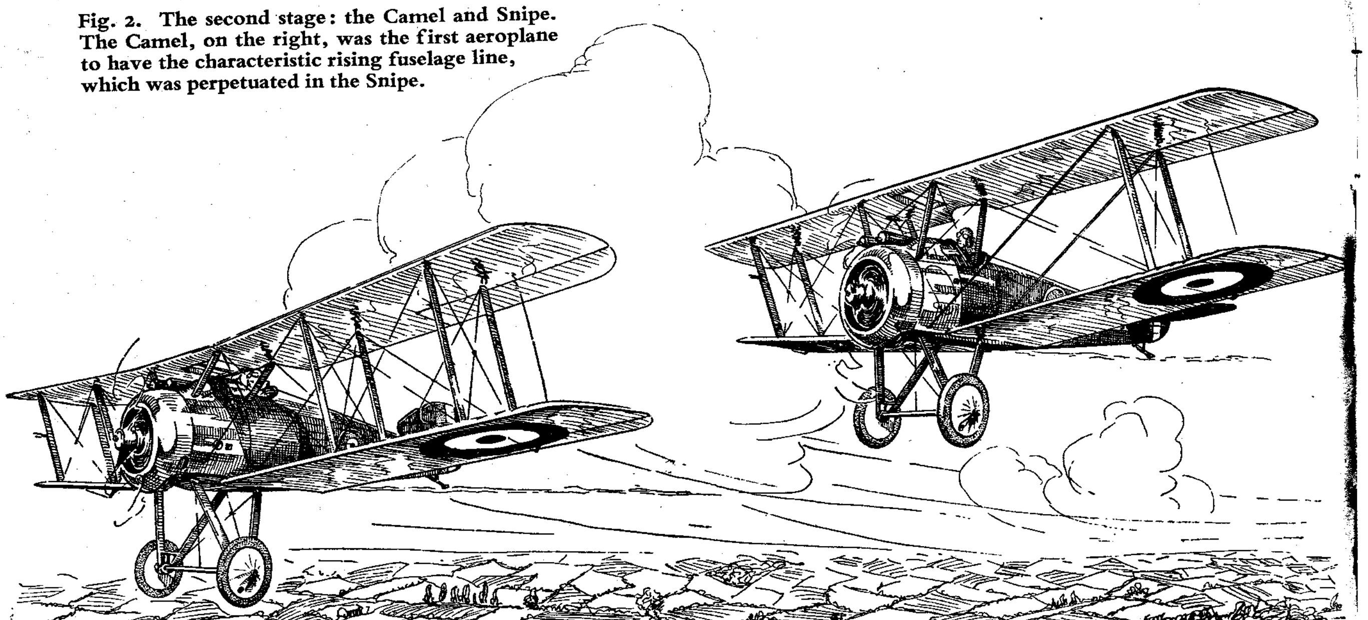
In 1914 the Sopwith Company was building sporting landplanes and seaplanes of attractive design and with a performance for power that was improved upon but slightly for twenty years. One of these types was a little single-seater, the Tabloid, with an 80-h.p. Gnome rotary engine. A more powerful version of this machine, mounted on floats, won the second Schneider Trophy Contest at Monaco in 1914. The Tabloid (Fig. 1) was adopted in small numbers as a single-seater scout by the Royal Flying Corps. It was at first flown unarmed, but was later fitted with a variety of crude armament, such as a Lewis gun arranged to fire obliquely past the airscrew.

By 1915 the Constantinesco gun synchronising gear had been invented, and the greatest difficulty in the way of fitting forward armament to a tractor aeroplane had been solved. The result of this was that the Sopwith designer, Harry Hawker, "modernised" the Tabloid and produced the Pup, often said to be the pleasantest aeroplane to fly that has ever been built. The view on the Pup was improved by staggering the wings; the 80-h.p. Le Rhone was fitted with a simple circular cowling, and the all-important Vickers gun was mounted on top of the fuselage in front of the cockpit. Such was the first British tractor aeroplane designed as a single-seater scout.

Fig. 1. The dainty little Tabloid: the Pup was virtually the same aeroplane with a slightly more robust structure.

The Pup was a first attempt at a fighter, and was followed in 1917 by the Camel (Fig. 2), the best and trickiest scout of the last war. The Camel was almost the same size as the Pup, but it had a 130-h.p. Clerget rotary engine. This comparatively high-powered engine in a small aeroplane made the Camel very smart on the controls and earned it its rather sinister reputation. (The torque reaction of the heavy rotary engine always tended to roll the aeroplane in the opposite direction.) The armament of the Pup had been doubled, and the two guns were partially enclosed in the humped cowling that originally gave the type its name. Four 20-lb Cooper fragmentation bombs could be carried in racks under the fuselage, making it in effect a fighter-bomber.

Fig. 2. The second stage: the Camel and Snipe. The Camel, on the right, was the first aeroplane to have the characteristic rising fuselage line, which was perpetuated in the Snipe.



In 1918 the Sopwith Company developed the Snipe (Fig. 2), which had all the manœuvrability of the Camel, with rather less trickiness. The Snipe came into service in the closing months of the war, just in time to show its superiority over the Fokker D VII, but not soon enough to earn the reputation it deserved. The Snipe, with its 230-h.p. B.R.2 rotary engine, was high-powered for its day, and remained one of the Royal Air Force's standard fighters until 1926. In this aeroplane the engine torque was overcome by increasing the span and giving both upper and lower planes a large dihedral—in the Camel the 13-degree dihedral of the lower planes tended to pull the flat upper plane down and give it a slight anhedral, adding to its instability. The armament of the Snipe was the same as that of the Camel, and was to remain standard practice for nearly twenty years; although one 1918 Sopwith type, the Dolphin, was equipped with two Vickers *and* two Lewis guns.

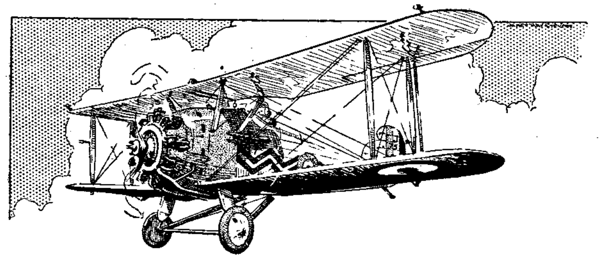


Fig. 3. The Woodcock, a rather unattractive machine with a radial engine instead of a rotary, but the rising fuselage line of the older types is still visible.

The Hawker Company

The Sopwith succession was taken over by the Hawker Company (which was formed after the war by the heads of the original firm), and in 1925 the Woodcock (Fig. 3) became the R.A.F.'s first specially designed day and night fighter. The Woodcock was not an attractive aeroplane, although it had something of the lines of the Camel, and its 380-h.p. Bristol Jupiter IV engine gave it a maximum speed of less than 150 m.p.h. In the Woodcock the Vickers guns were mounted externally on the sides of the fuselage.

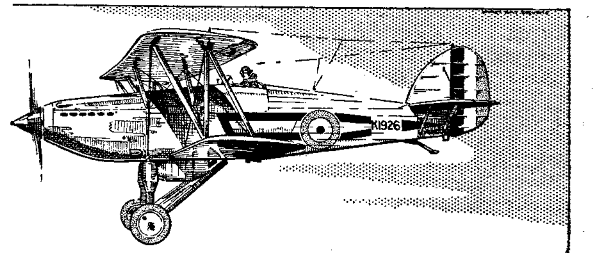


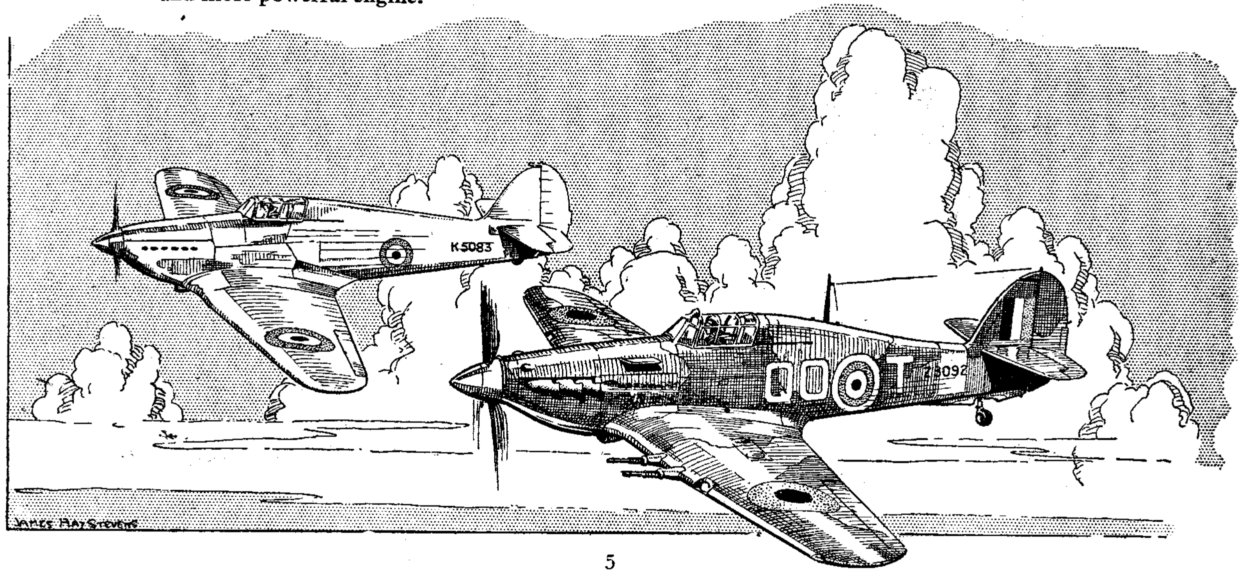
Fig. 4. The Fury, one of the most beautiful service biplanes ever built. The aeroplane shown bears the two red bars that were the marking of No. 1 (F) Squadron.

The Liquid-Cooled Engine

1929 saw the appearance of the Fury (Fig. 4), originally called the Hornet, which created a sensation as the first 200-miles-an-hour Service aeroplane. (There was a step between the Woodcock and the Fury—the Hornbill, with a liquid-cooled Rolls-Royce Condor engine, but as this article is limited to actual R.A.F. production types it is not considered here.) The Fury was an attractive machine (with the same fuselage line rising to the cockpit and the forward stagger which gave the Camel pilots such a good view), but it was not its good lines alone that gave it its fine performance: it was the smooth power of the 590-h.p. Rolls-Royce Kestrel engine. The cowling of the Kestrel engine was not unlike that on the Hurricane; but the radiator under the fuselage was not ducted as in modern installations, the airflow through the block being controlled by shutters at the front instead of by an outlet flap. The armament of the Fury was still two synchronised Vickers guns (this time carried in troughs on top of the fuselage), but the externally carried fragmentation bombs were dropped in the general clean-up for high performance.

The Fury remained the acme of fighter perfection for a number of years (although there were only three squadrons of them Nos. 1, 25 and 43), and put up some magnificent single and formation aerobatic shows at Hendon year after year. The F.A.A. version of the Fury was the Nimrod, a similar aeroplane but with exclusively stainless

Fig. 5. The prototype Hurricane and one of the later developments, the Mark IIc. Note how the original lines followed those of the Fury and were later modified to take the cannon, variable-pitch airscrew, and heavier and more powerful engine.



steel fittings and anodised cowlings as protection against salt spray. The Fury was developed in a number of ways—reduced wing area, cleaned-up undercarriage, higher-powered engines, etc.—until in 1934 the Hawker Company designed a P.V. low-wing monoplane fighter which was virtually a Fury fuselage with a single wing attached to it. This aircraft was never built, but it formed the link between the Fury and the Hurricane.

In its original form the Hurricane bore a distinct resemblance to the Fury, but later developments to the Merlin engine installation rather changed the shape of the nose (Fig. 5). The Hurricane first flew at the end of 1935, and began to reach squadron service in 1937. The prototype Hurricane (and the early production aeroplanes) had a wooden fixed-pitch airscrew, a short nose, and fabric-covered steel and duralumin wings. The fuselage lines were straighter, the tailplane was strut-braced and the tailwheel was semi-retractable. The nose shape was changed when the Merlin engine was fitted with vacuum and hydraulic pumps on the front cover and an oil-retaining ring round the front of the cowling behind the spinner. The open exhausts of the prototype were first replaced by pepper-box flame dampers, and then by the familiar triple ejectors. The fin under the fuselage was added to overcome spinning troubles.

Fighter and Bomber

The Hurricane started life as the world's first real multi-gun fighter—the policy of eight machine-guns capable of firing for a very limited period being considered very radical. Later, when our production of 20-mm. Hispano cannon made it possible, it was fitted with four such guns, and at the same time another modification brought in a 12-gun version, the Mk. IIA. At about this time, 1941, the aeroplane was daringly fitted with wing racks to carry two 250-lb. bombs. Soon two 500-lb. bombs were carried—and the bomb load then equalled that of the standard medium bomber with which we started the war, the Bristol Blenheim.

But these changes were only the beginning; two 40-mm. anti-tank guns were next fitted, to be used with success against the lightly armoured tops of the German tanks in Libya. Finally, the 40-mm. guns were superseded by the deadly R.P. with their priceless feature of no recoil. There were also the various versions of the Sea Hurricane with catapult spools and arrester hooks.

The Hurricane is certainly one of the great aeroplanes of history: it bore the brunt of the day fighting in the Battle of Britain; it was a good single-engined fighter in the night blitz that followed; it started the rout of the long-range Focke-Wulf Kurier Atlantic raiders, operated first from catapult-equipped merchant ships and later from carriers; and when outclassed as a fighter it returned to the offensive against the German aerodromes and their armour in the field with bomb and rocket.

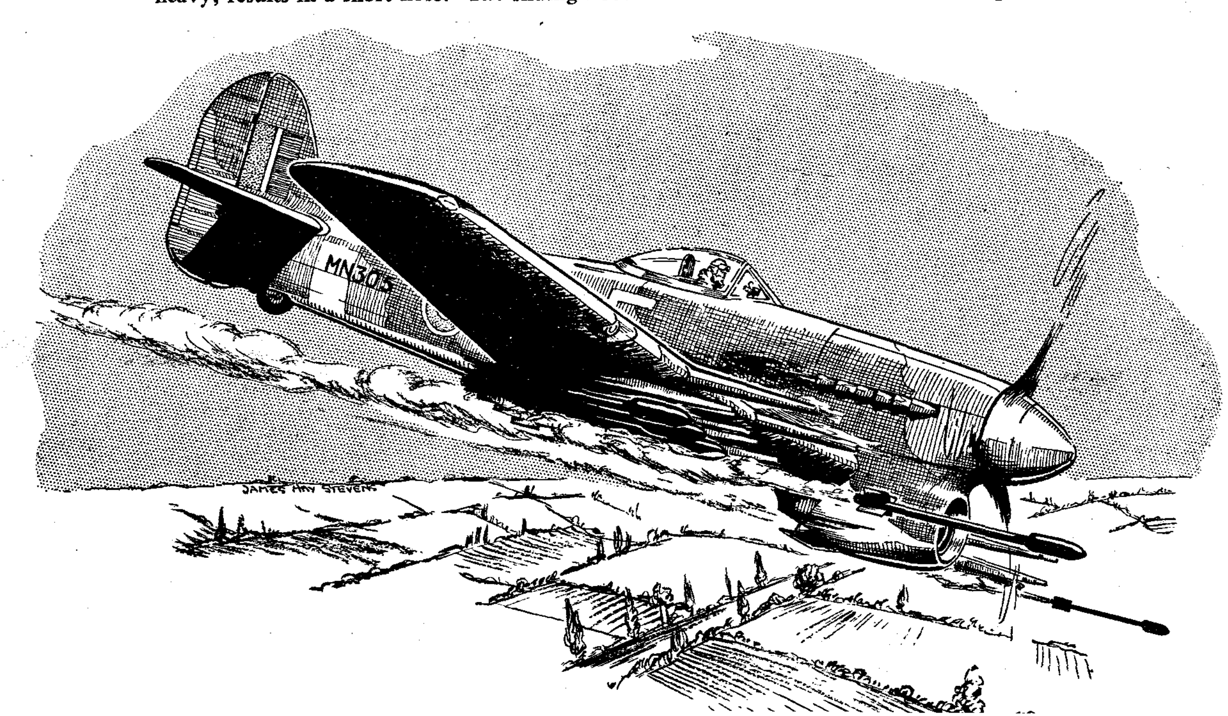
As the Hurricane's day drew to a close the Typhoon (Fig. 6) took up the challenge. Originally built to take interchangeable Sabre or Vulture power plant units, this design was stabilised on the 2,200 h.p. Napier Sabre. A new engine and a new airframe together naturally had some teething troubles. However, by 1942 the Typhoon was in full service and was the mainstay of our defence against the low-flying tip-and-run fighter-bombers that raided the South Coast in that year. The Sabre has a single-stage supercharger and is a medium altitude engine, so that it had a considerable advantage over the Merlin for this work.

Soon, however, the Typhoon was used in the fighter sweeps over France. The majority were fitted with four 20-mm. cannon, but some still had twelve .303 machine-guns. The Typhoon retains many features of the Hurricane; the wide track undercarriage, concentrated armament and, above all, an excellent view and handling qualities. Probably its poorest feature is the very short nose with the massive combined radiator, oil cooler and air intake under it. This arrangement gives the swirling airscrew slipstream little time to smooth out before passing over the wing, with a consequent danger of vibration troubles.

Soon the inevitable happened and the Typhoon was fitted with bomb racks and rocket rails. The fighter had become a low-level bomber and "strafer" with either two 1,000-lb. bombs or eight 60-lb. rockets, not to mention the four 20-mm. cannon with 120 rounds each. Throughout the offensive on the Western Front in 1944 the Typhoon has played a leading part as the ideal tactical aircraft.

Before the Typhoon was well into service the Tempest was on the stocks. In effect the Tempest is a Typhoon fuselage with semi-elliptical wings of a rather thinner section. The nose has been lengthened to improve the entry and a forward extension to the fin balances the extra side area. A most noticeable feature is the clean installation of the four 20-mm. cannon as shown in the heading sketch. The good view is maintained by the blister cockpit hood, and the fine ground handling qualities are retained by the wide track undercarriage.

Fig. 6. The latest rocket-firing version of the Typhoon. The Sabre engine, being very powerful and therefore heavy, results in a short nose. The sliding hood is the latest of three versions of cockpit cover.



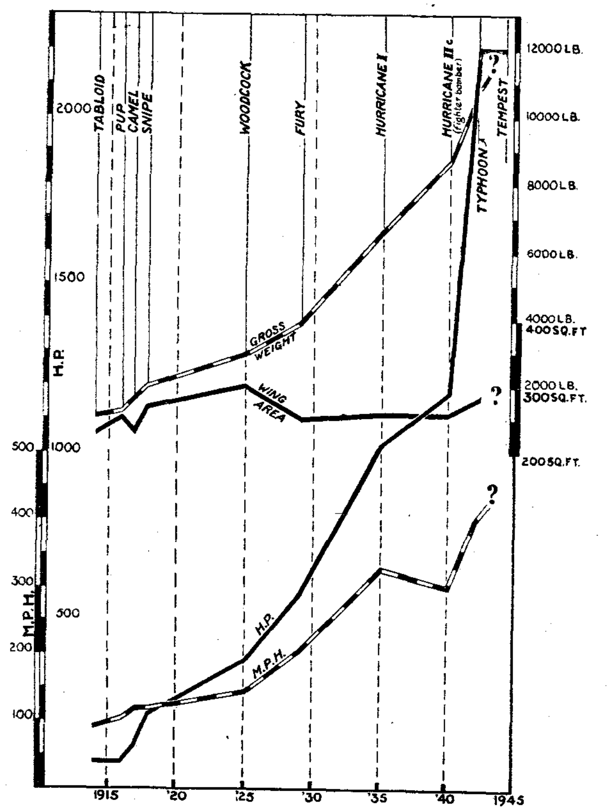


Fig. 7. A graph showing how the salient features of fighters (power, speed, gross weight and wing area) have changed in thirty years. The overall increases are approximately: power 27:1; speed 5:1; weight 10:1; wing area 1.4:1, i.e. practically constant.

The performance of the Tempest is still secret, but there is no doubt that it has a maximum speed well in excess of 400 m.p.h. and that it is a match for any other fighter in service to-day.

The Price of Performance

The graph which forms Fig. 7 was drawn in order to give some idea how the passage of time has affected the main characteristics of these fighters. It is particularly interesting to notice the very high cost of increases in speed and armament—the two operational features that are at the root of all the other changes. During the Four Years War speed increased by about one-third, ceiling (climb) and armament were doubled *at the cost of nearly trebled power.* With the increase in armament and engine weight the structure became proportionately heavier, and there was some increase in wing area to keep the landing speed low.

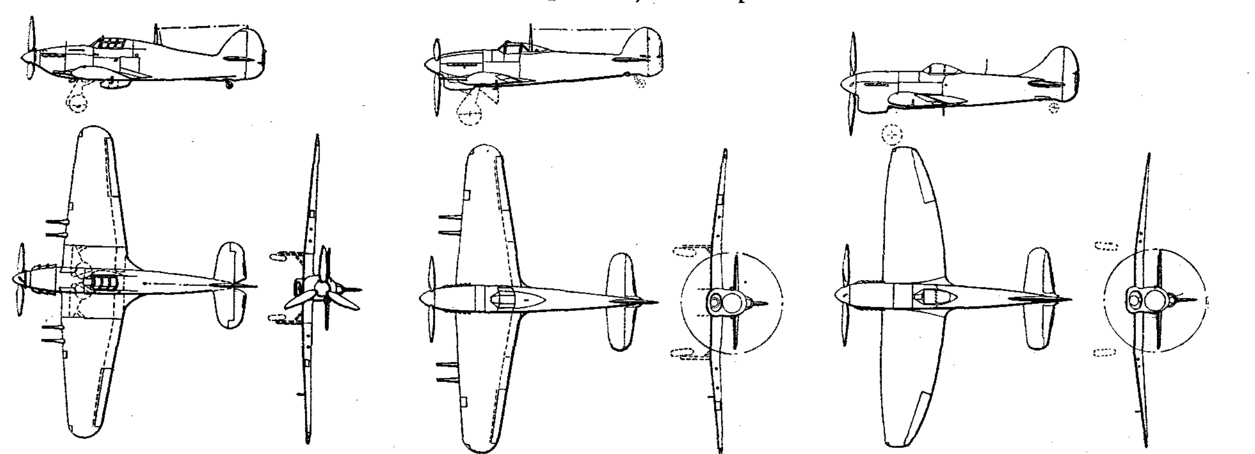
Between the wars the Woodcock showed little gain in speed, but its heavier engine again put up the structure weight and wing area. The Fury continued to gain in weight due to extra (and liquid-cooled) power, but the wing area was reduced to increase maximum speed at the cost of a high landing speed.

With the first low-wing monoplane the power, weight (made up in extra engine weight, strength and armament) and speed made a big leap forward, but the wing area remained almost the same as the Fury. The reason for this latter fact was partly an increase in landing speed, but mainly the use of a high-lift wing section and flaps.

Development during this war has been marked by a vast increase in weight, partly accounted for by extra power, but mainly by the installation of more and more armament and the conversion of fighters into bombers. The result of this has been the raising of wing loadings and landing speeds to figures that were considered fantastic for any but racers before the war. (The interested reader may find some amusement by working out the wing and power loadings from the curves in Fig. 7.) Of course, the extra aerodynamic loads imposed by high speeds also add directly to the weight because of increased structure strength; but by and large armament takes the heaviest toll, while engine power (an indirect result of speed) is a close second.

This brief review covers thirty years, from 1914 to 1944, in the development of the single-seater fighter by three successive designers; Harry Hawker, Fred Sigrist and Sidney Camm, three men who have succeeded each other and carried on a tradition so smoothly that it is possible to trace the progress of this type, one to another, from the germ of the idea to the magnificent Tempest of to-day.

Fig. 8. Three-view G.A. drawings of three versions of the Hawker fighters of this war: Hurricane IIC, Typhoon IB (early cockpit cover) and Tempest.



Flying the CORNELL

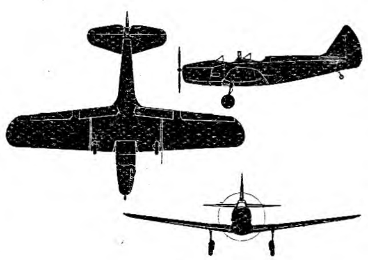
by W. A. DEAN

FAST replacing the sturdy old Tiger Moth as one of the main elementary training types in the R.A.F. is the American Fairchild Cornell. On reaching E.F.T.S. you may fly the PT-26 version, which is fitted with most of the levers and gadgets common to such types as the Oxford and Harvard, the major differences being the non-retractable undercarriage, fixed-pitch airscrew and unboosted engine. This helps, of course, to make the graduation to more advanced types, such as those mentioned above, a much easier proposition than was the case in the old Tiger days.

One of the first things that strikes you about the Cornell is the general similarity to the usual fighter type of layout. Totally enclosed cockpits are fitted, the view from both being extremely good. Except when instrument flying under the hood, you as the pupil will always sit up in front, from which position the cowling blind spot is negligible, even whilst taxying.

From left to right of the cockpit, the main controls and instruments are in this order. At the side of the seat, the manually operated flap lever and fuel wobble pump. Above them are the throttle, mixture control, tail trimmer and fuel cocks to the wing tanks. The usual instruments are to be found on the centre panel, as well as a complete blind-flying set. The switches for the retractable landing-light, cabin heating, navigation lights and so on are neatly grouped in two rows on the right of the panel. Lastly, attached to the right-hand side of the cockpit, are the identification and Morse light switches and the parking brake.

Other features of the PT-26 worthy of note are the steerable tailwheel, hydraulic toe brakes, electric push-button starter and adjustable seat and rudder pedals.



Taking Off

The cross-wind cockpit check just before taking off consists of the mnemonic "T, M, Fuel, Flaps, Gyro," as follows:

T—Trimmer back one turn (1½ when solo).
M—Mixture fully rich; carburettor air to cold.
Fuel—To correct tank; sufficient for flight.
Flaps—Up.
Gyro—Uncaged and set on aircraft's heading (into wind).

Finally, hood checked locked open and harness locked. Then turn into wind and open the throttle right up.

After becoming airborne at 65 m.p.h., the Cornell is flown level with the ground until the optimum climbing speed of 75 m.p.h. is reached, the trimmer being wound back to relieve the stick pressure. Incidentally, the trimmer is operated by a small handle in the same direction as the pressure on the stick which is to be cancelled out.

When a height of 300 ft. is reached the hood may be closed and the mixture control leaned off slightly. A decided pressure is needed on the right rudder pedal at full throttle to counteract the swing to the left. In fact, to do an accurate left-hand climbing turn a small amount of *right* rudder must be left on. After you have levelled out and throttled back to the cruising speed of 90 m.p.h. (2,050 r.p.m.), this pressure is no longer necessary.

On account of the ample rudder area very little movement of the pedals is needed to execute a correct turn. For the same reason spin recovery is simple; although spinning is quite a lot steeper and faster than in the Tiger.

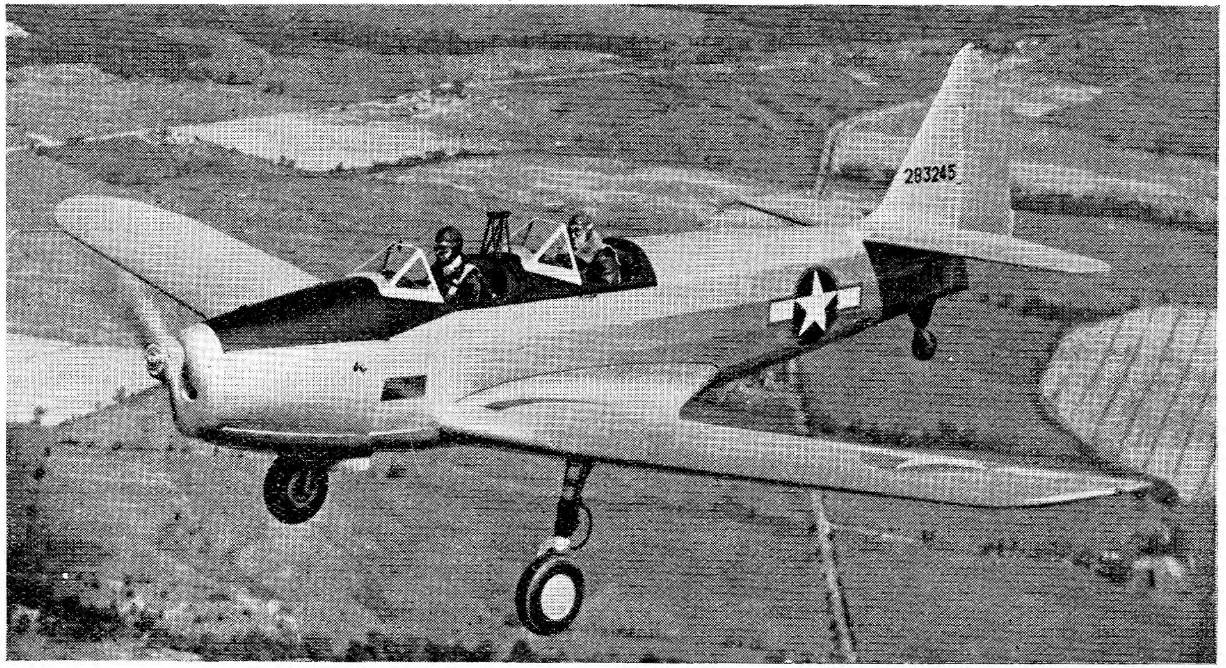
Landing

After cutting the engine at the appropriate position on the last cross-wind leg the flaps are lowered, the speed adjusted to 80 m.p.h. and the throttle opened again to about 1,400 revs in order to carry out the normal power approach and landing. The trimmer is wound back à turn or two and a gliding turn made into wind at a slightly increased speed. Into wind the speed is kept at a steady 80 m.p.h., any tendency to under- or overshoot being remedied by varying the throttle opening. For instance, if you are undershooting, the throttle is moved forward and the stick moved back. The former makes the approach shallower and the latter keeps the speed steady. A common fault is to try to stretch the glide by just pulling the nose up or opening the throttle without moving the stick—instead of using the two in conjunction.

The difference in gliding speed with the flaps up is only slightly greater, so for the sake of simplicity the speed is still taken as 80 m.p.h. A half-way flap position is fitted to enable the correct forced-landing procedure to be carried out—that is, half-flap across wind and full flap after turning into wind. The main effect of the flaps is to steepen the gliding angle and reduce the float period.

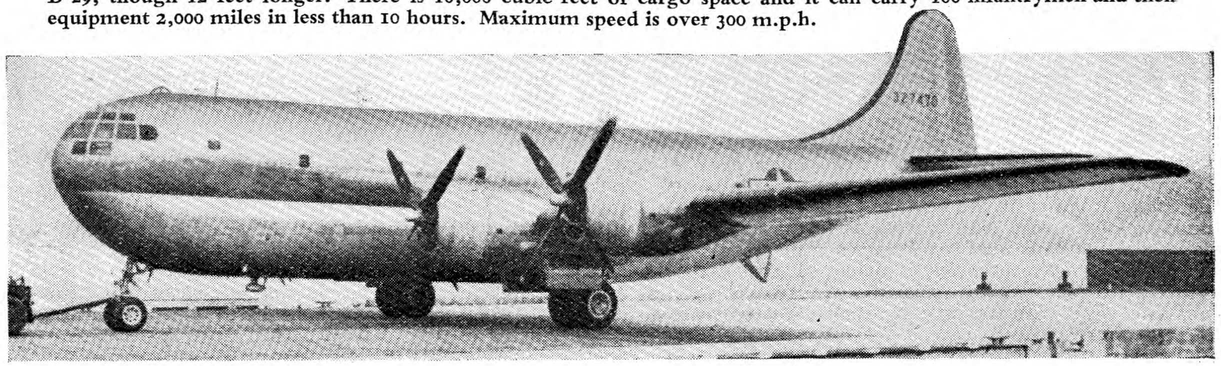
After the hold-off the landing is fairly straightforward on account of the small nose-up movement required to bring the aircraft into the three-point position. The wide-track undercarriage—almost a third of the span—also helps to prevent digging in a wing when landing, as well as making taxying in windy weather much safer.

Forgetting about the flaps and returning to the tarmac with them still down may mean a fine at many stations, as they can soon become damaged by stones, so the first action after landing is to turn out of wind and bring them up. Lastly, the tail trimmer is wound back fully, this helping to keep the tail down when taxying.



A pupil under instruction in an American Cornell.

The C-97 cargo plane—counterpart of the B-29 Superfortress. With the exception of the fuselage it is identical to the B-29, though 12 feet longer. There is 10,000 cubic feet of cargo space and it can carry 100 infantrymen and their equipment 2,000 miles in less than 10 hours. Maximum speed is over 300 m.p.h.



Less Drag from Jets

by A Naval Air Engineer Officer

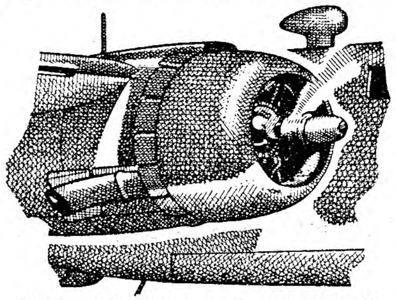
CONSIDERED as a means of propulsion only, the jet propulsion unit, consisting of a rotary air compressor, combustion chamber, gas turbine and jet discharge nozzle, compares unfavourably at present with the ordinary engine and propeller combination. Its efficiency is much lower, particularly at powers below full power. The fuel consumption per mile of the V1 flying bomb was approximately the same as that of the four-engine Lancaster bomber which carries six times the bomb load in addition to its crew and a greater quantity of fuel. The V1's propulsion unit was primitive of its kind, because it relied on its speed to compress the air, but even in an orthodox unit with a rotary air compressor it is estimated that for every unit of thrust horse-power obtained four more are required to drive the turbo-compressor unit. Is this loss of efficiency the price which must be paid to obtain higher speeds than are possible with the conventional engine and propeller or are there any compensating factors with which to credit the account?

Power Plant Drag

Drag may be defined as the force which opposes the flight of an aircraft. In a normal aircraft the power plant, which includes the oil coolers and coolant radiators and their respective tanks, probably has a greater influence on the total drag than any other factor. High speeds require larger power plants, but, as they increase, the proportionate effect of the drag is greater, since at the highest speeds it may vary as V^4 or V^5 where V is the speed of the aircraft. Cowlings are fitted around the power plant to give a streamlined effect, but they do not reduce the frontal area exposed to the air resistance. Likewise, the radiators may be fitted in ducts in such a way that some of the heat extracted from the oil or coolant is converted into thrust which partially counteracts the drag they set up.

With a jet-propelled aircraft it may be possible to arrange the propulsion unit in the fuselage in such a manner that the design of the fuselage can be governed mainly by aerodynamic considerations. An attempt on these lines was made in the Bell Airacobra, where the engine is buried in the fuselage behind the pilot's seat, but in such installations the long shafting between the engine and the propeller is liable to bring troubles due to torsional vibration. The illustration of the Gloster aircraft shows how a clean, streamlined effect can be obtained with jet-propulsion engine in the fuselage.

In larger aircraft designed for carrying heavy loads it may be possible to arrange a series of jet engines in the wings in a manner that reduces the drag considerably in comparison with a similar aircraft driven by a number of propellers. The logical development of this would be an all-wing design of aircraft, one with no separate tailplane and with the fuselage not extending aft of the mainplanes. The advantages claimed for an all-wing aircraft are considerable, but a design difficulty encountered hitherto has been to find a means of balancing the weight of the engines and propellers, which are necessarily mounted either on the heaviest part of the wing, i.e. the main spar, or in the nose of the fuselage. The position of a jet engine is much more flexible.



"A great influence on the total drag."

A jet-propulsion unit may also be arranged in the aircraft to reduce the effects of another form of drag. When an aircraft is in flight particles of air in immediate contact with the wings or fuselage may be regarded as sticking to them and travelling along with them. Only a very little way above, less than one-tenth of an inch in certain parts when the aircraft is travelling at high speed, other particles of air are streaming aft at the speed of the aircraft. Between these two lines is a layer of particles of air whose speed relative to the aircraft varies from 0 to 450 miles an hour, or whatever may be the speed of flight. This layer is known as the boundary layer. It accounts for much of the drag or total resistance to forward motion. If the layer can be kept thin, so that the inner line of particles are sheared clean from the outer line of particles, the airflow is said to be laminar, and the resistance is small. On the other hand, if the boundary layer is thick it will be full of small air eddies, and the resistance or drag will be considerably greater due to the clinging of the particles much the same way that treacle clings to a spoon withdrawn from it. This is known as turbulence flow.

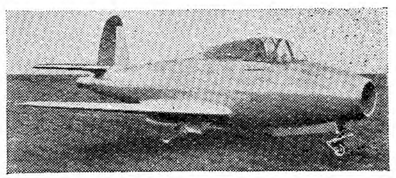
Boundary Layer Control

At high speeds there is laminar flow at the leading edge of the wing, but it breaks down to turbulence flow before reaching the trailing edge. Obviously the nearer to the trailing edge this breakdown occurs the less will be the profile drag. The object of boundary layer control is to retain laminar flow as much as possible and to prevent it from breaking down to turbulence flow. There are two methods of control, the object of each being to reduce the thickness of the boundary layer.

(i) Prandtl's method has slots in the wings or fuselage through which air from the boundary layer is drawn away from the surface slightly aft of the point where laminar flow would otherwise break down.

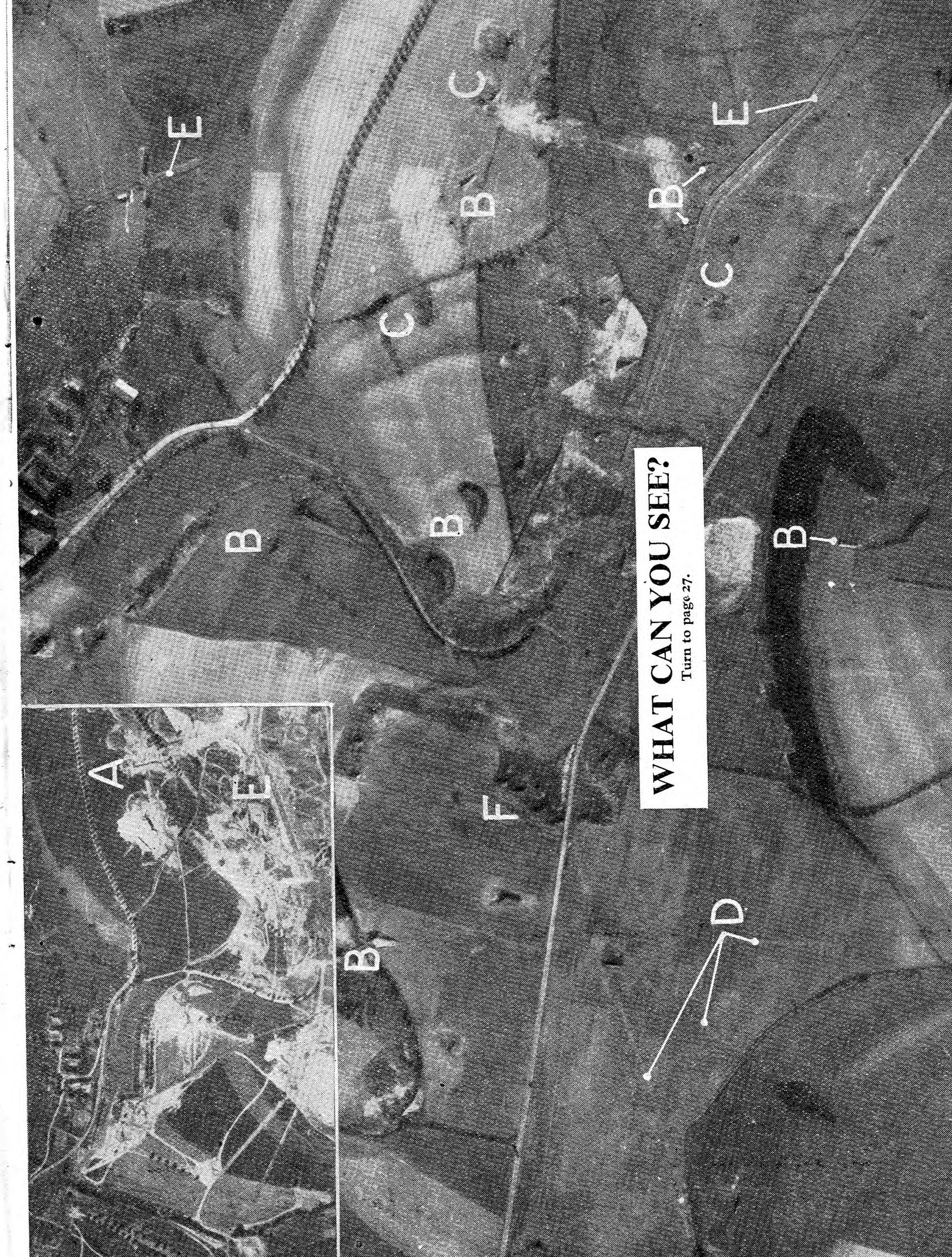
(ii) Baumann's method ejects air over the surface of the wing or fuselage in order to restore the laminar flow by increased pressure.

The jet-propulsion unit can incorporate either of these methods. In Prandtl's method small intakes facing forward can be introduced at suitable distance from the leading edge to admit air from the boundary layer into the suction of the compressor. There is a patent in Air Commodore Whittle's name covering this method. In Baumann's method air at a pressure can be introduced further aft to maintain laminar flow in the boundary layer where otherwise it would be turbulent. The drag of a modern aircraft, especially at high speeds, consists to such a large extent of drag due to turbulence flow in the boundary layer that a greatly improved performance would be secured if it were possible to have only laminar flow.



The Gloster aircraft shows how a clean streamlined effect can be obtained with jet propulsion.

It is thus seen that **although as a propulsive unit a jet engine in an aircraft is inefficient compared with a reciprocating engine and propeller, it can be fitted to give the aircraft a better performance by reducing the profile drag.**



Flying in RHODESIA

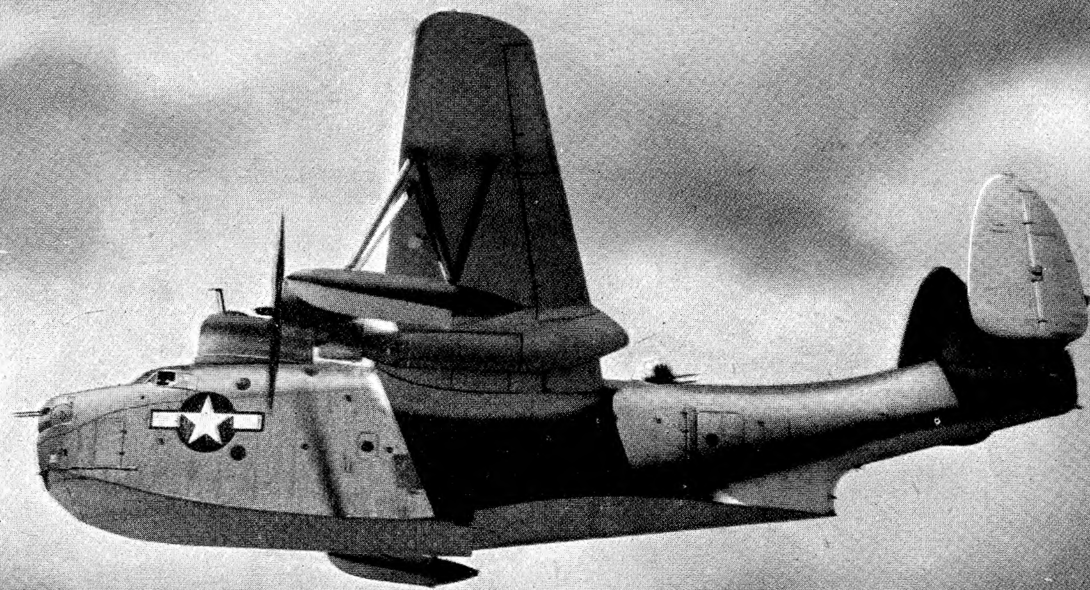
SOUTHERN RHODESIA is a sub-tropical, self-governing colony bounded on the north by the great Zambezi river and on the south by the "great green greasy Limpopo River". It consists mainly of grassland and open bush country, there being no "jungle" and no desert. No rain falls for six months of the year, from May to October, but this is made up during the other months of the year when heavy daily showers and occasional tropical thunderstorms bring its annual rainfall average up to that of Great Britain. It lies at an altitude of about 4,000 feet, and because of this and in spite of the almost continual sunshine, its climate is pleasant throughout the year. There are wild, dangerous animals and snakes in the country, but the R.A.F. visitor rarely sees them. There are, however, numerous kinds of small buck and game birds in spite of the encroachment of European civilisation, and on most of the farms sport with a gun can still be obtained. Insects of many fearsome looks appear at the beginning of the wet season, but most of them are quite harmless. An exception is the malarious mosquito, and during the wet season it is necessary to sleep under a net and go from shorts to slacks for evening wear to avoid being bitten.

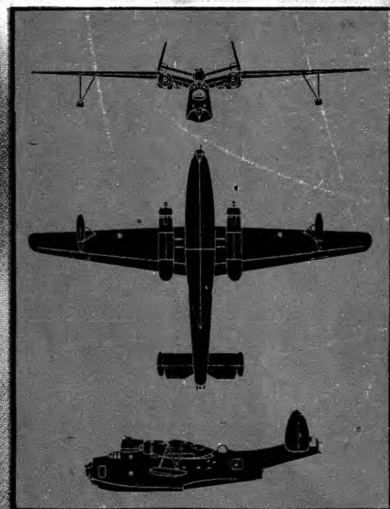
The first Europeans to discover the country were the Portuguese in the sixteenth century, and some of them must have been given to understand that there was much gold to be obtained there. They did obtain a little, but the gold mines which provide a large part of the colony's revenue nowadays were not discovered until the nineteenth century, mainly by hunters and prospectors from Great Britain. During the development of the Rand gold mines at Johannesburg and the Kimberley diamond mines in the Union of South Africa Cecil Rhodes was attracted by this country north of the Limpopo, and in 1890 organised the Pioneer Column which travelled from the Union and established the capital city of Salisbury on its present site. Rhodesia is, of course, named after Cecil Rhodes.

The Rhodesian Air Training Group came into being early in 1940, and a history of its development and the work it does is shortly to be published. A great number of pilots, navigators and air-gunners have been trained in Rhodesia. The great advantage it has for flying training is that in spite of the frequent and heavy rains from November to May, flying can go on almost without a break throughout the year. Its disadvantages are its great distance from sources of supply, its height above sea-level, which involves longer take-off runs, and the dust which abounds in the dry season and entails some abnormal wear of engine parts.

Flying in Rhodesia is pleasant, although the country itself, from the airman's point of view, is uninteresting. From May onwards there are clear skies and bright sunshine, and in June, July and August it can be quite cold in the early morning, even becoming frosty at times. In August there is usually a haze of dust and smoke from grass fires, which occasionally reduces the visibility to ten miles or less. Later in the year it grows hotter and hotter, and from September clouds appear in the sky as the day advances, clearing away at night. These become more frequent, the air is bumpy and the weather oppressive, until November, when the rains start. The first rains clear the air like magic, the veld gradually turns green, and the general feeling of relief is enormous. This is the planting season, and natives and farmers are all hard at work with their main crops of maize and tobacco. Through the period of the English winter flying is usually only interrupted in the afternoon, and the rain storms are usually so isolated that it is possible to fly round them. Some very impressive sunsets can be seen from the air at this time of the year, the western sky red, the lightning playing about isolated storms, and the tops of the towering nimbus clouds being tinged with pink.

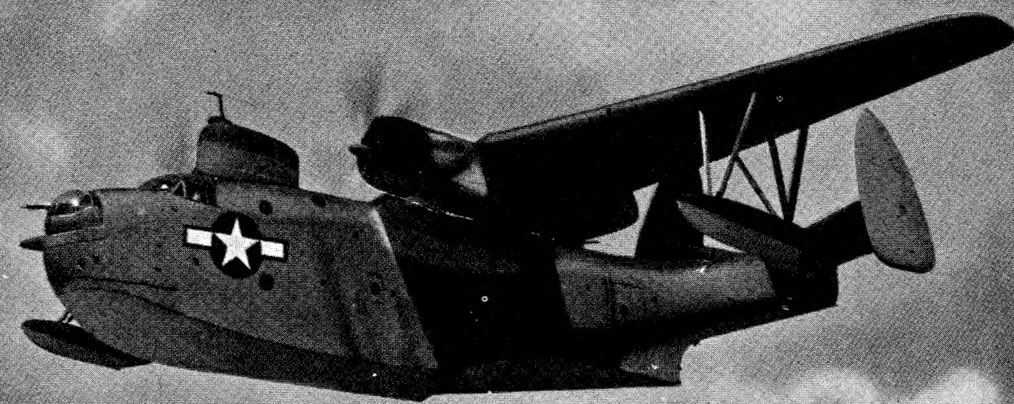
This small, peaceful part of Africa, which up to the outbreak of war had seen very few aeroplanes, has now for four years vibrated to the roar of Harvard and Oxford.



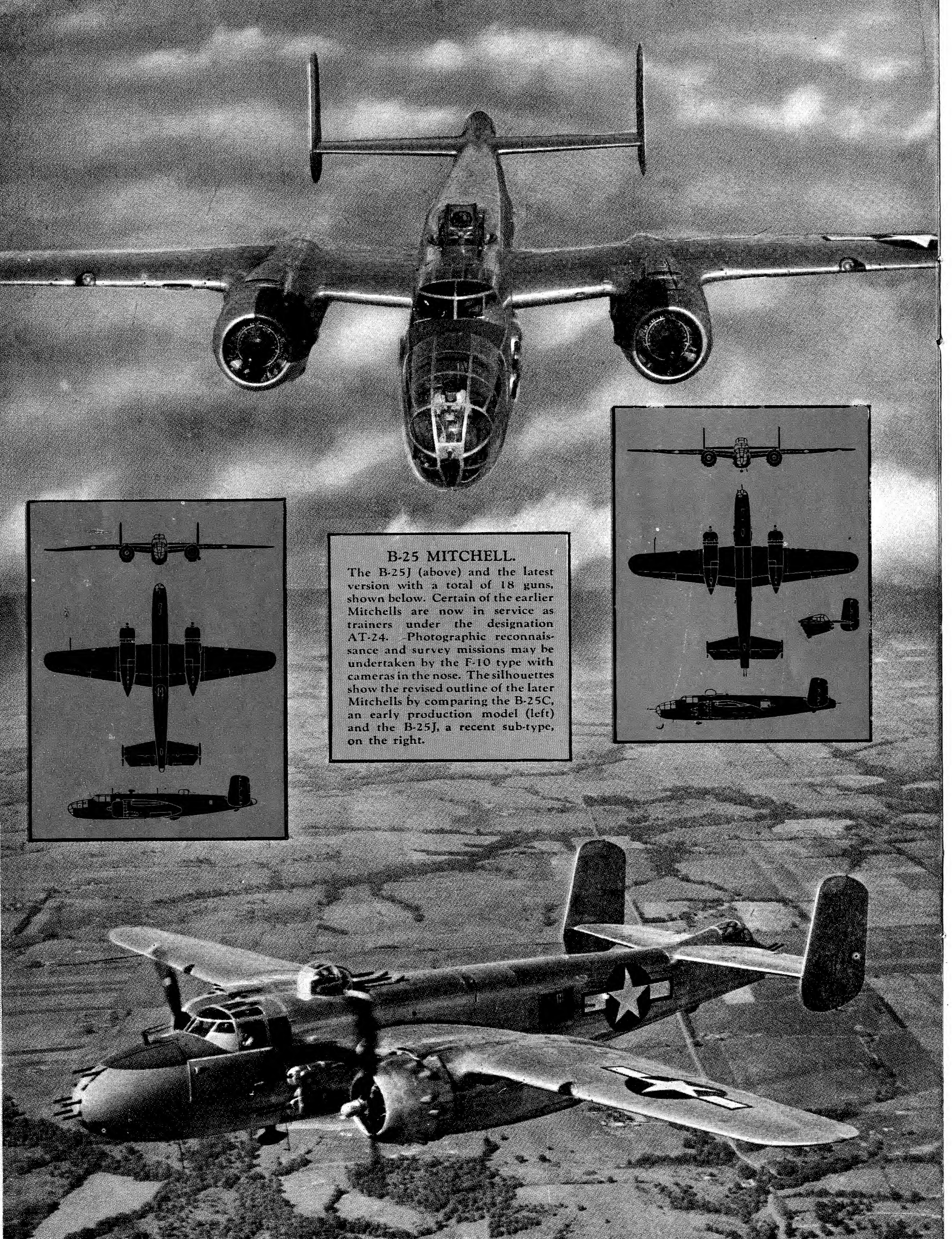


PBM MARINER.

The Martin Mariner is used in numbers by the U.S. Navy for both patrol and transport work. The transport version, the PBM-3R, differs from the patrol-bomber shown here in having the armament and anti-submarine gear removed. Mariners are also employed on coastal patrol and convoy escort duties. For long-range work sponson fuel tanks are fitted to the hull, increasing the range by 60%. Reduction in the maximum speed due to the extra drag of these tanks is claimed to be only 2%.



Spitfire Mark XII.



B-25 MITCHELL.
The B-25J (above) and the latest version with a total of 18 guns, shown below. Certain of the earlier Mitchells are now in service as trainers under the designation AT-24. Photographic reconnaissance and survey missions may be undertaken by the F-10 type with cameras in the nose. The silhouettes show the revised outline of the later Mitchells by comparing the B-25C, an early production model (left) and the B-25J, a recent sub-type, on the right.

Engine RATINGS

By J. A. Kyd

VERY often when we are studying some subject and are attending lectures we come across some little point which we don't quite understand —although everyone else appears to. This little point may be the link that connects everything together in our minds, but because of its apparent insignificance in the eyes of the instructor, or because we appear to be the only dim-wit, we refrain from putting out any questions. And so it goes on.

One such point which is very seldom explained at any length in textbooks and which is so simple when understood that a lecturer is apt to take it for granted, is this business of engine rating. We hear such phrases as "rated altitude," "full throttle height" or "international power," and then we may hear that "the so-and-so engine develops its power low down," or "high up," as the case may be. Then we sometimes hear of an engine's performance quoted in "h.p.s" and sometimes in "b.h.p.s." What is the reason for all this jargon and what does it all mean?

As is well known the h.p. quoted for a motor-car or motor-cycle bears no real relationship to the power developed by the engine; it is purely a figure arrived at by means of a formula taking into account the cylinder bore and the number thereof in the engine. It is called "horse-power" for power of the engine, whether it be for car or aircraft, is what it develops when it is being run against a "brake." This brake is a machine which can be adjusted to impose any desired load upon an engine, and at any loading it is known what h.p. is required to drive it at any particular speed of rotation. Hence the term "brake horse-power." It was, of course, the original intention that it should be plain h.p., but the corruption of this term for motor-car-engine taxation purposes has led to the use of b.h.p. when it is desired to quote the true power of any engine.

The horse-power of several different designs of car engines may work out at 10, but the brake horse-power of these engines may vary between 28 and 42, depending upon the particular design of engine and the function for which it is intended. An example is that of the Austin Seven engine. This 7 "h.p." engine develops round about 20 b.h.p. when designed for use in a family model, but when redesigned with an overhead crankshaft and a supercharger and put into a single-seat racing car it probably develops five times this power.

A change in the method of car taxation has recently been announced by the Chancellor of the Exchequer. After the end of this year it will be an engine capacity tax instead of an "h.p." tax, and then presumably we shall hear car engine sizes quoted in litres, which in fact some manufacturers already do. Whether or not car engines will then have their brake horse-power quoted in advertisements remains to be seen. If so, it is probable that we shall revert to plain h.p., since the cause of confusion will have been removed.

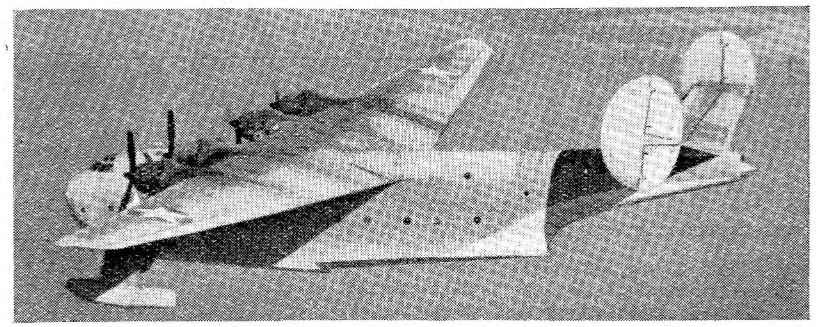
Now we come to the point about the ratings. The engine being discussed is supercharged and is fitted with an automatic boost control (as all modern supercharged British aero-engines are). We read in the advertisements that it produces 1500 b.h.p. —jolly good. But what is strange is that the technical journals seem to be making much more fuss of the fact that it has got a rated power of 1250 b.h.p. at 15,000 ft., and this is sometimes called the "international power rating." The reason for the apparent lack of any great interest in the maximum power output of an aero-engine lies in the fact that the engine is built in as light a form as possible consistent with safety, and at the same time it has to have a ready reserve of power to deal with take-off and emergencies in flight. This reserve of high power is never likely to be needed for longer than five minutes at a time, and so the engine weight, and consequently strength, is kept down to a figure which allows operation at full power for only very limited periods.

The full power is thus not so very important in the eyes of the operator; what he is interested in is the international power rating. Quoted as a certain power at a certain engine speed at a certain height, the international power rating tells him what is the greatest altitude at which the engine will maintain the highest power at which it can be run for as long as an hour and at what engine speed. All other factors being equal, the engine which develops its power at the greatest altitude is of most use to the aircraft it drives, as due to the decrease in air density the higher the aircraft flies, the faster it goes.

There are exceptions to this ideal, of course. An aircraft designed for convoy escort duties doesn't want to spot for U-boats at 15,000 ft., nor does a torpedo-carrying machine wish to launch its missile from that height, and many other instances are only too obvious where the engine will never be called upon to operate at any great height. In these cases the engine is said "to develop its power low down." What is really meant is that advantage can be taken of the low-altitude duties assigned to the aircraft to modify the supercharger so that it requires less power from the engine to drive it, and this power at once becomes available at the propeller end of the engine as additional b.h.p. The engine which "develops its power high up" expends as much as 100-200 h.p. in driving the supercharger alone (the b.h.p. quoted for an engine is what remains when the crankshaft has driven the supercharger and all the other accessories), and at low altitudes the engine is very severely throttled by means of the automatic boost control to prevent the dense atmosphere from entering the supercharger in very large volume and causing very high boost pressures which would wreck the engine. The capacity of the supercharger and hence the power required to drive it can thus be reduced considerably on an aero-engine which is only required to operate near the ground.

Although it will develop more power than its brother with the big supercharger, the low-altitude engine will not be able to make a certain aircraft go as fast at its international altitude as the high altitude engine at its international altitude. As was stated earlier, this is due to the reduction in drag as height is gained.

Engines for the Martin Mars total 8,000 h.p.



Piper Cub

by ROY CROSS

THE story of the Piper Cub follows closely the growth of light-plane aviation in the United States, where the slogan "Flying for the man-in-the-street" had come nearer to realisation before the war than in any other country. The vast distances across country argue well for the cheap and economical aerial runabout which cruises at about 80 m.p.h. and can land in any small open space with a reasonable surface. The Cub fulfilled well these requirements. The aeroplane was of sound design and sturdy construction, an excellent and easy flyer, a good performer, with a reliable, economical motor. Maintenance compared not too unfavourably with that required to keep a medium-sized car in good running order, spares and expert technical advice being readily obtainable from the local representative of a widespread organisation of Piper service stations and dealers. These facilities, plus a progressive public relations policy which, among other things, provided eight hours' free dual flying instruction for the prospective buyer, clinched the Cub's popularity, so that sales went up and the prices down.

In 1941, however, rearmament upset this happy state of affairs, as the resources of the American aircraft industry were increasingly directed towards the expansion of the air forces. The Piper Corporation, beset by the problem of how best to assist in the new programme, decided that owing to their unrivalled experience in light aeroplane design and construction, they would continue to build their own products, concentrating on trainers for the Civil Pilot Training Program. Attempts were also made to interest the authorities in the military potentialities of the light aeroplane. In the late thirties a Cub was used by an artillery officer of the Texas National Guard to direct his batteries' fire. When the National Guard was mobilised in 1940 a group of high-ranking officers received permission to ask the Piper Corporation for five demonstration aeroplanes for spotting and liaison duties. Later, in 1941, Cubs were fully tested during extensive Army manœuvres, and a number were delivered to the U.S. Army Air Corps for service trials at Wright Field. Large contracts were awarded for the O-59, later known as L-59, and finally as L-4.

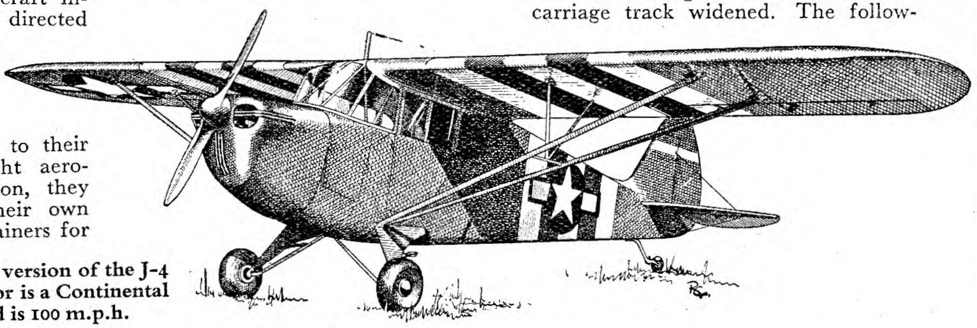
Piper production is now concentrating on the L-4B, C and D (J-3), the L-4F and G (the Cruiser), the UC-83 (J-4 Coupe) and the TG-8 training glider for the Army, the NE-1 and HE-1 for the Navy, and the J-3 trainer for the C.A.A. War Training Service (W.T.S.).

Cub History

The first Cub flew on September 10th, 1930, the idea being to provide a cheaper and lighter club aeroplane than had hitherto been available, and thus give the clubs a chance to operate at a reasonable profit during the slump of that time. It was produced by the Taylor Aircraft Co. In 1937 this company was reorganised as the Piper Aircraft Corporation, and its former president and chief engineer, C. G. Taylor, formed the Taylor-Young Airplane Co., which makes the Taylorcraft. A development of the first Cub, the E-2, with a Continental A-40 motor, continued in production until 1936, with little change in design. In early 1936 the J-2 was introduced, with lines very similar to those of the modern J-3. Wing tips were rounded off, rear fuselage built up, the tail surfaces redesigned and the undercarriage track widened. The following year when the old Taylor Aircraft Company was reorganised as the Piper Aircraft Corporation, taking over a new works in Lock Haven, Pennsylvania, advantage was taken during the move to plan the factory layout for quantity production. The Piper Corporation claims that first use was made at this plant of many production line methods and processes now in general use. In spite of this shifting and re-installing of plant, 707 Cubs were sold in 1937, and a new model, the J-3 Sport, appeared in November of that year.

The Sport

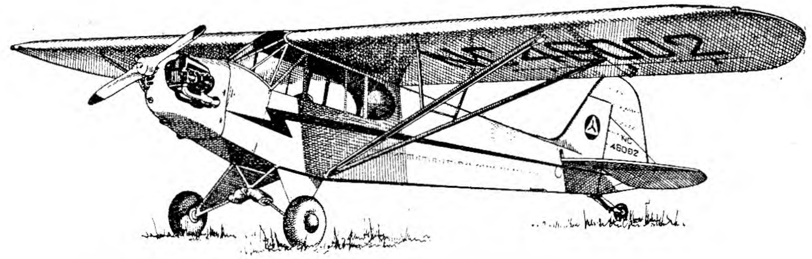
The J-3 incorporated some fifty design changes from the J-2. Larger faired-in fin, revised cabin windows and a general streamlining, improved handling, view and performance. Space in the tandem cabin was increased by modifying the firewall and shifting a cross member at the rear of the cabin backward some three inches. Dual control, baggage space, car-type upholstery and a wind-down window made the J-3 ideal for the less wealthy flyer. In 1938 a model of the J-3, especially suited to the flying club, was

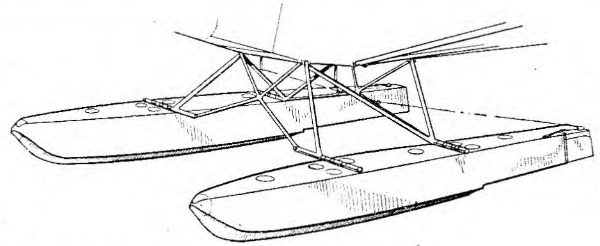


The Piper UC-83, a Service version of the J-4 Coupe two-seater. The motor is a Continental A-75-8, and the top speed is 100 m.p.h.

PIPER CUB J-3 TRAINER
(65 h.p. Continental motor)

Span	35 ft. 2½ in.
Length	22 ft. 3 in.
Empty weight	660 lb.
Loaded weight	1,160 lb.
Max. speed	90 m.p.h.
Landing speed	35 m.p.h.
Initial rate of climb	500 ft./min.
Service ceiling	12,000 ft.



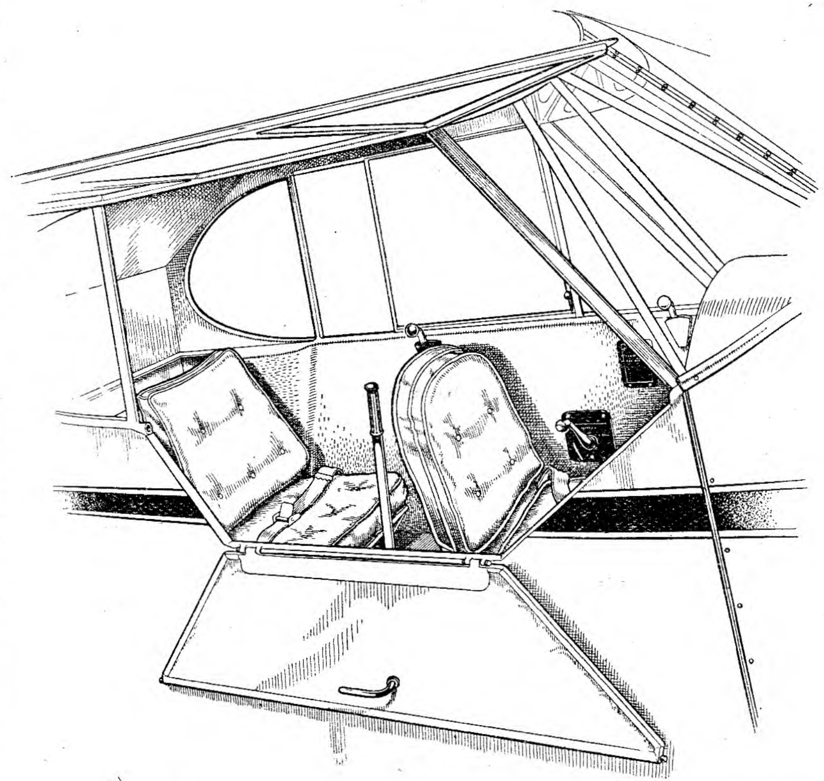


CUB DETAILS

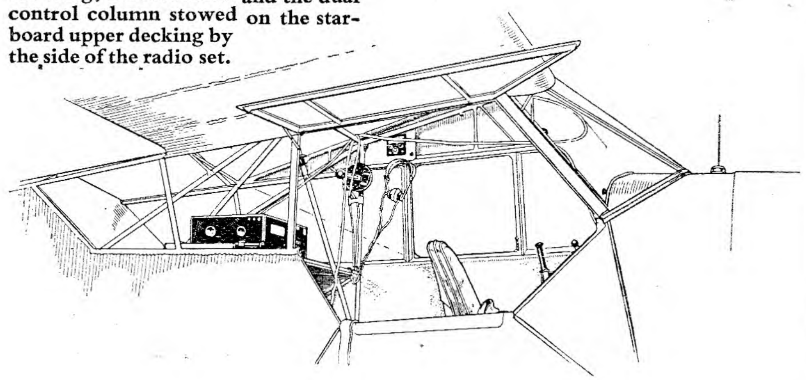
Above: the J-3 trainer, used extensively by the Civil Aeronautics Authority War Training Service (late Civil Pilot Training Programme).

Left: the float undercarriage, interchangeable with wheels or skis, as fitted to the Cub.

Below: inside the Cub Sport, showing the tandem seating and simple furnishing.



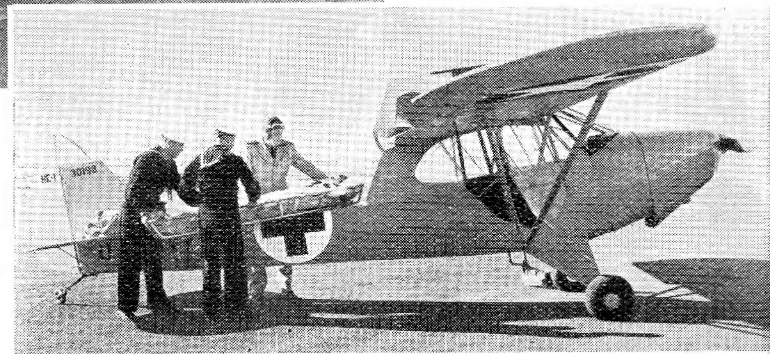
Radio equipment installed in the L-4 liaison aeroplane. Note the extension of transparent panels to well aft of the wing, the reel aerial and the dual control column stowed on the starboard upper decking by the side of the radio set.

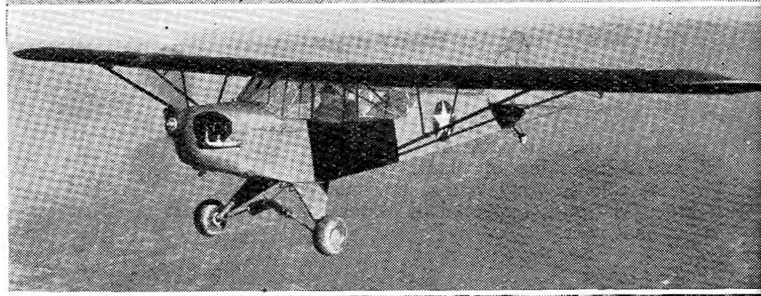


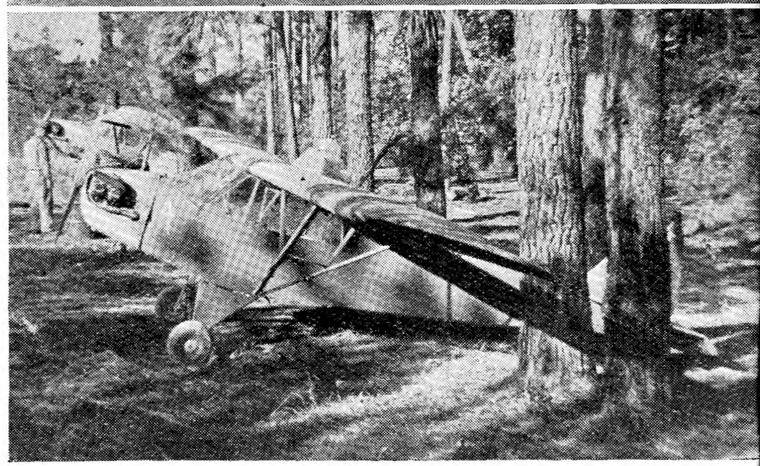
PIPER L-4 GRASSHOPPER
Navy designation NE-1
(65 h.p. Continental motor)

Dimensions	See Cub J-3
Empty weight	750 lb.
Loaded weight	1,170 lb.
Max. speed	90 m.p.h.
Cruising speed	85 m.p.h.
Landing speed	35 m.p.h.
Initial rate of climb	650 ft./min.
Service ceiling	12,000 ft.
Range	260 miles

Top to bottom; Views of the Piper HE-1 Naval ambulance (left and below), the L-4, and Piper Cubs sheltering on the fringe of a wood during the U.S. Army manoeuvres of 1941, for which a number of light planes were loaned, with their civilian pilots, to the Army for experiments in air co - operation with ground forces.



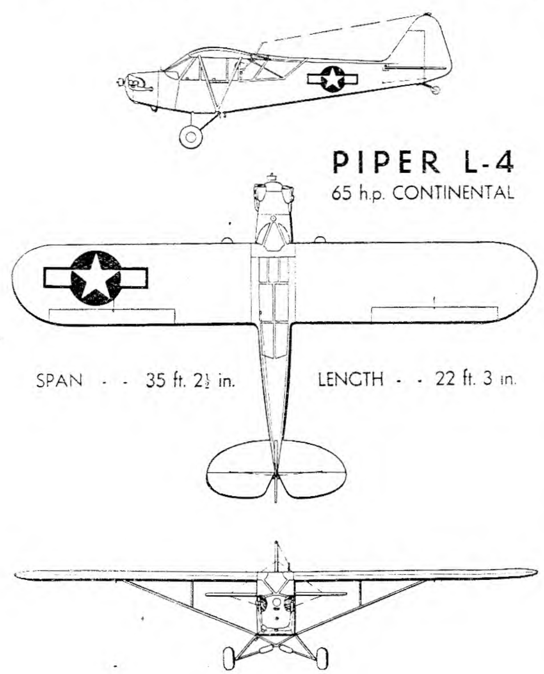




produced and called the Cub Trainer. The standard power plant was still the 40-h.p. Continental A-40 air-cooled flat-four horizontally opposed motor (introduced in 1931, since when over 8,000 have been manufactured), while approved type certificates were obtained for the Cub with 50-h.p. motors of Continental, Lycoming, Menasco and Franklin types. The Coupe, seating two side by side, was also seen for the first time in 1938, being a larger and more expensive job. In 1940 the Coupe interior was re-styled, and by 1941 it had a 75-h.p. motor with starter mechanism, built-in RCA radio receiver with provision for installing a transmitter, wind-driven generator, battery and luxury interior. A service version is designated UC-83.

Early in 1940 another step forward was taken with the introduction of the J-5B Cruiser, primarily for charter and taxi service with commercial operators. With 75-h.p. Continental A-75-8 or Lycoming engines respectively, the J-5A and B accommodated three persons, the pilot sitting in front of the two passengers. The 25-gallon fuel capacity allowed a cruising range of 450 miles, affording extreme economy with regard to operational cost. A 100-h.p. motor gave the J-5C Super Cruiser a 10 m.p.h. advantage in maximum speed over the Cruiser, but range for the same fuel capacity dropped to 300 miles. The Cruiser is used by the A.A.F. as the L-4F (J-5A) and L-4G (J-5B). Modified J-5Cs are employed by the U.S. Navy as light ambulances (HE-1).

Interest has been displayed by the Piper Corporation in the trend towards the simplification of flying controls, especially in light types. The immediate aim is to eliminate the rudder bar, so the sideways movement of the stick or wheel will give both turn and bank, coordinating both rudder and aileron movement. Although this simplification might take some of the pleasure out of flying, more people would be able to, or would take the opportunity to fly, and perhaps there would be a smaller percentage of flying accidents due to mismanagement of controls. Possibly the new 40-h.p. Piper Skycycle airport runabout, which is ultra-light, has a plastic fuselage and is intended to sell at around £150, will have this car-type simplified stick-cum-rudder arrangement.



PIPER L-4
65 h.p. CONTINENTAL

SPAN - - 35 ft. 2½ in.   LENGTH - - 22 ft. 3 in.

Exit V.1.

BOOKS

Unofficially Reviewed by the Editor . . .

Arnhem Lift

The Diary of a Glider Pilot. Pilot Press. 5/-.

Published anonymously, this is a brief record of a glider pilot's experiences at Arnhem. It gives no coherent story of the whole operation, but presents vivid pictures of how the operation looked and felt to one man.

Per Ardua

By Hilary St. George Saunders. Oxford University Press. 15/-.

A history of the Royal Air Force from its start in 1911 as the Air Battalion of the Royal Engineers to 1939. The history of the last war accounts for 280 of the 356 pages, the subsequent history of the R.A.F. being briefly dealt with up to 1939.

The Biology of Flight

By Frederick L. Fitzpatrick and Çarl A. Stiles. Allen & Unwin. 8/6.

Two professors here discuss bird and insect flight, air sickness, altitude sickness, flight fatigue, anoxia, acuity of vision and other matters of physiological interest to anyone who flies. Some interesting diagrams, bibliography and a useful index.

Air Aces

Thirty-two Studio Portraits by Gordon Anthony with biographical notes by John Macadam. Home & Van Thal. 12/6.

The photographs are consistently good. The notes vary in length and quality, some being a little racy and others in the style of an Air Ministry communiqué. An expensive book.

Atlantic Bridge

Stationery Office. 9d.

The official account of the R.A.F. Transport Command's Ocean Ferry, which started in 1940 the difficult job of flying much needed aircraft to this country, thus speeding up victory in the air and saving thousands of tons of shipping. A good account of a job well done.

The Geography of World Air Transport

By J. Parker Van Zandt. Faber & Faber. 5/-.

Written in America, this book attempts to correct geographical misconceptions based on ordinary maps and to present a view of the world as it must appear to the organisers of air travel.

No Specific Gravity

By B. J. Hurren. Published by Temple Press Ltd. 6/-.

Reviewed by Engnr. Rear-Admiral J. E. G. Cunningham.

A life's accumulation of good yarns and stories. The miscellany takes us all over the world, in peace and in war, with nights of gladness and days of anxiety, rowdy guest nights in home messes and rough games of football abroad. One of the best chapters is the advice to those arriving for a spell of duty in the Near East. A man's book, full of interesting adventures and so crowded with joviality and humour that it will be specially welcomed in all three Services.

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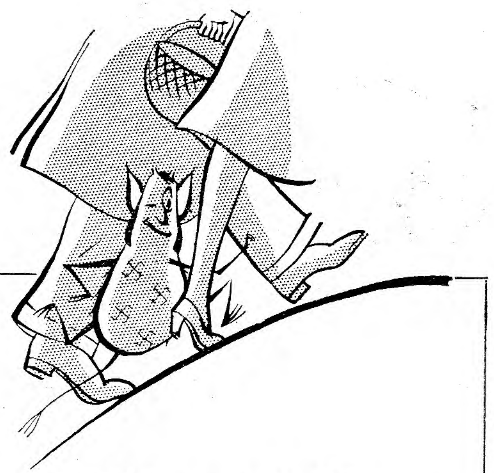

Jack and Jill went up the hill
With the Squander Bug to shop, Sir ;
Both came down without a crown
And the trip was quite a flop, Sir.

Jack and Jill have had their fill
And don't know who was dafter ;
They now repent the money they spent
And save for the war and after.

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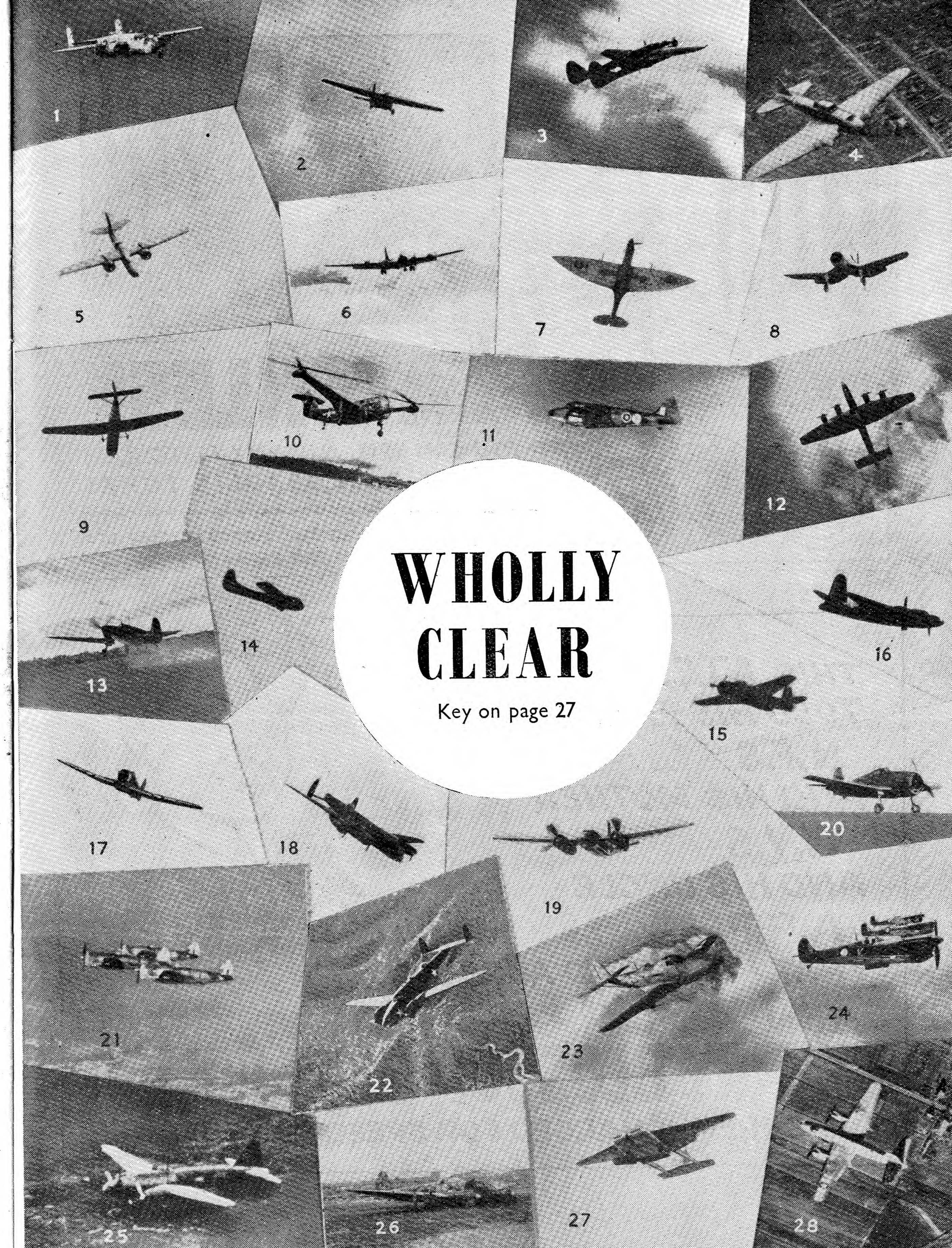

Wholly Clear

(SEE PAGE 25)

1, North American B-25 Mitchell; 2, General Aircraft Hamilcar I; 3, Northrop P-61 Black Widow; 4, Iliuchin IL-2; 5, Douglas A-20J Havoc; 6, Boeing B-29 Superfortress; 7, Supermarine Spitfire VII; 8, Vought F4U-1D Corsair; 9, Airspeed Horsa I; 10, Platt Le Page YR-1; 11, Airspeed Oxford I; 12, Handley Page Halifax III; 13, Supermarine Seafire III; 14, Waco CG-4A Hadrian; 15, Grumman TBF-1 Avenger; 16, Martin B-26C Marauder; 17, Hawker Typhoon IB; 18, Avro Lancaster III; 19, Douglas A-26 Invader; 20, Grumman F6F Hellcat; 21, Republic Thunderbolt IIs (U.S. P-47Ds); 22, Lockheed PV-1 Ventura; 23, Bell P-63 Kingcobra; 24, Supermarine Spitfire Vcs; 25, Mitsubishi Betty 11; 26, Heinkel He 111H; 27, General Airborne Transport XCG-16A; 28, Martin Marauder.

Partly Plane

(SEE PAGE 23)

1, Avro Lancaster III; 2, Lockheed C-69 Constellation; 3, Handley Page Halifax II; 4, Boeing Fortress I (B-17C); 5, General Aircraft Hotspur II; 6, Fairey Firefly F.1; 7, Consolidated B-24J Liberator (R.A.F. Mk. VI); 8, General Aircraft Hamilcar I; 9, Avro York I; 10, Waco CG-4A Hadrian; 11, General Airborne Transport XCG-16A; 12, Boeing B-29 Superfortress; 13, Douglas DC-7; 14, Short Sunderland I; 15, Consolidated PB2Y-3R Coronado; 15, Waco CG-4A Hadrian; 17, Airspeed Horsa I; 18, Short Stirling I.

What Can You See?

How Photographic Reconnaissance and Interpretations kept constant check on the Siegfried Line Defences (see page 11)

THE use of shadows to detect banked-up strongpoints and the tracing of cable trenches, etc., due to the different tone of disturbed earth are well illustrated in this photograph of part of the forward area of one of the strongest sections of the Siegfried Line, south-east of Sweibrucken, situated on rising ground which commands a fairly extensive view. Inset: The same district in September 1939, showing work in progress and tremendous track activity. Communication trenches at (A) have since been ploughed in, and though the numerous casemates are well camouflaged by banked-up earth they may be located by entrance shadows (B), fire embrasures (C) and cable trenches (D). The strength of the section is well illustrated by the two rows of dragon-teeth anti-tank obstacles (E) and the presence of a battery of four medium guns in adjacent casemates (F). Only a few of these batteries exist in the Line, and they are the heaviest casemate guns known to be in use.

The majority of the gun casemates contain anti-tank or machine-guns, and are generally situated to provide entrance cover fire (C). Shelter casemates for reserve personnel, stores or ammunition are distinguished by lack of fire embrasures, narrowed or curved entrances, and usually have a cupola for observation purposes or possibly to contain light machine-guns (B).