AIR TRAINING CORPS GAZETTE
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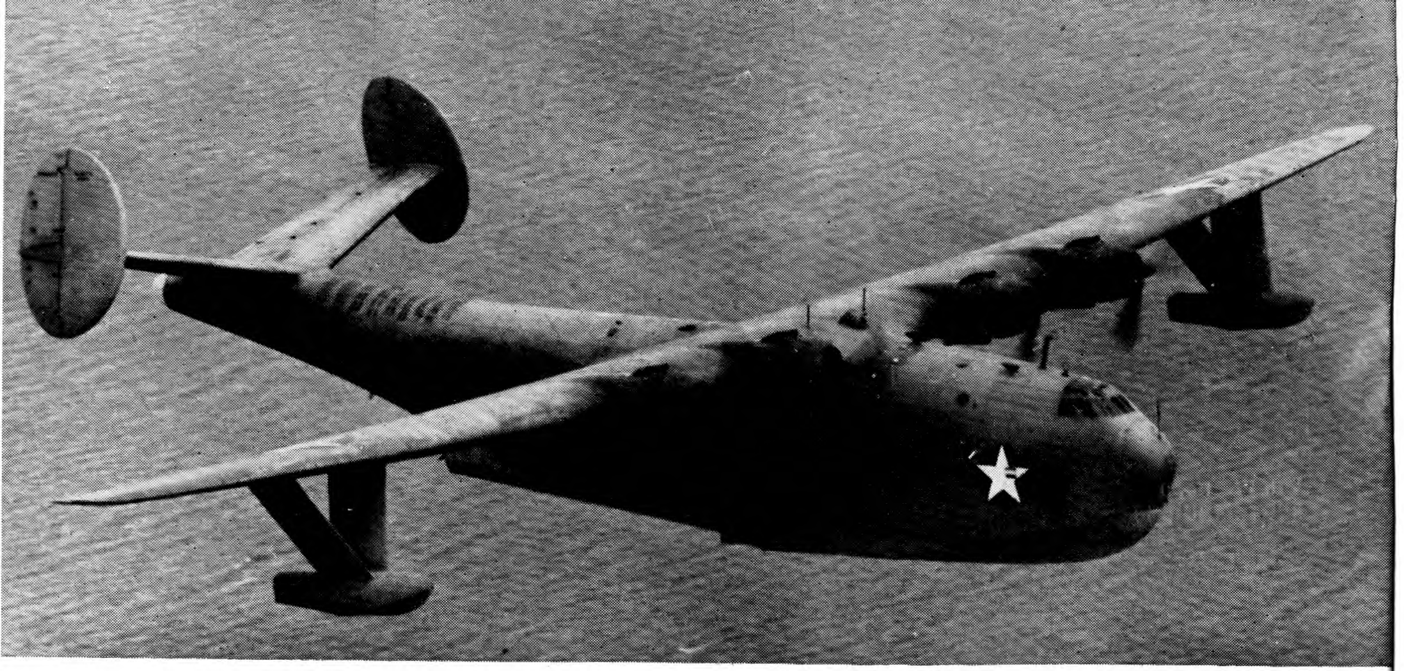
SEPTEMBER 1944



The Mars flying boat, built by the Glenn L. Martin Company, Baltimore, U.S.A., has been taken over recently by the U.S. Navy and thus became an essential part of the United States fleet as a transport. The Martin Mars has made recently a final test before being taken over by the U.S. Navy. This was a non-stop flight of 34 hours and 17 minutes from the Pacific to Hawaii at 185 miles-an-hour average. It has four 2,200 horse power engines, weighs 37½ tons plus the 15 crew, 20 passengers and 14,000 lbs. of cargo. Its wing-spread is 200 feet and it has got an overall length of 175 feet.

AIR TRAINING CORPS GAZETTE

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The Chief Commandant's Visits

DURING July I was able to inspect a number of units in North-West, Central, Midland, East and South-West Commands, and was glad to see that the high standard of efficiency which I have seen elsewhere is being maintained. Particularly I would like to note the parade and ceremony on the occasion of the presentation of colours to No. 476 (2nd Erdington, Bromford and Gravelly Hill) Squadron. This was followed by the presentation of a Cadet glider and an outstanding flying display by Vickers' chief test pilot and R.A.F. test pilots on Spitfires and a Lancaster. This Cadet glider was constructed, in their spare time, by gliding instructors and cadets of the squadron and by cadets of Nos. 165 (Dunlop), 482 (Wolseley) and 495 (Sutton Coldfield) Squadrons, and its workmanship was of a very high order. The event took place at the flight sheds of Messrs. Vickers Armstrongs Ltd.—makers of the Spitfire and other famous aircraft—who are tireless in their work for No. 476 Squadron.

Co-operation

The spirit of co-operation and team-work between the several squadrons, and between the Corps and industry, which this occasion typified was an inspiration.

Cambridge

At Cambridge Airfield a very good display was given by No. 104 (Cambridge) Squadron; and afterwards I was able to inspect their headquarters, also those of Nos. 734 (Technical School) Squadron and 536 (Perse School) and 688 (County High School) Flights.

Stockport and Harrow

My visits to Midland Command included an inspection of Stockport Grammar School Flight. And in Central Command I attended the official opening of No. 1454 (South Harrow) Squadron's new headquarters, where the Bishop of Willesden made a moving address; visited No. 568 (Watford Grammar School) Squadron for their "open day"; witnessed a fine sports display of the Harrow pre-Services Association, where the A.T.C. and W.J.A.C. combined against the other cadet services; and at Finchley saw a fine public tattoo arranged by No. 1825 Squadron in co-operation with the Air Scouts and W.J.A.C.

Cornwall

In South-West Command, where I attended conferences of the Cornwall County Committee and Commanding Officers, a first-rate guard of honour was provided by Truro Squadron. Their smart turn-out spoke well for their drill instruction. Later I visited cadets of No. 71F (Redruth) and 24F (Penzance) Squadrons and Devonport Grammar School at annual training with the Fleet Air Arm in a very fine camp.

The Empire

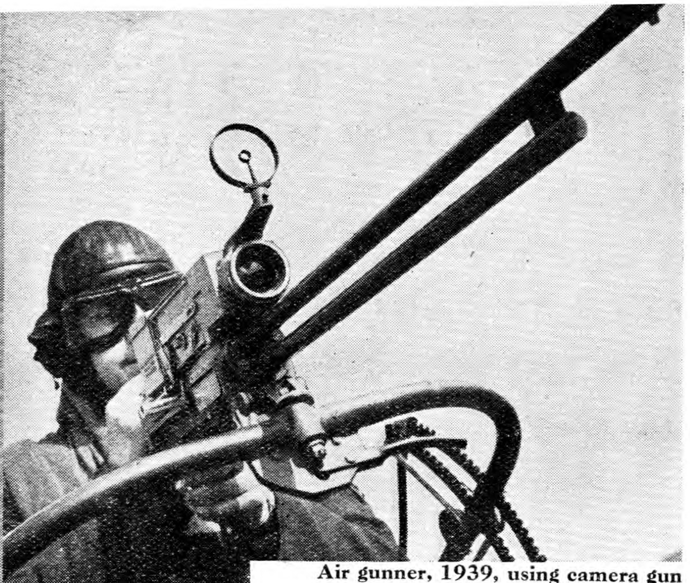
During the month I also had the privilege of giving a lecture on the Air Training Corps to the officer pupils and staff of the Empire Central Flying School. This was a singularly fortunate occasion, because the Corps in Britain has recently been getting closer together with our "opposite numbers" in the Dominions. Air news about the Dominions will be a regular feature in the *A.T.C. Gazette* in future; and I strongly commend every cadet to learn all he can about air developments in the Empire, for I believe that Britain's future greatness will depend very largely on our air communications with the rest of the British Commonwealth, and the use which the Empire makes of the great air power we have built up together.

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

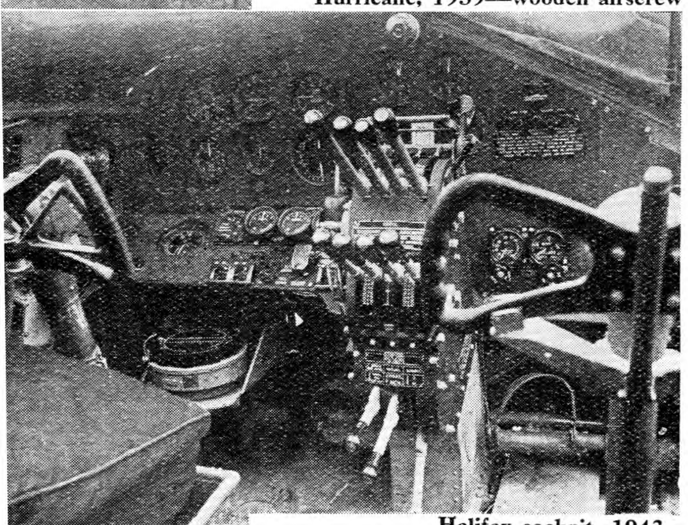
Air Chief Marshal Sir William Mitchell, K.C.B., C.B.E., D.S.O., M.C., A.F.C., the A.T.C. Commandant for London, who died last month, has left a gap in the A.T.C. that will be hard to fill.

A genial man, accustomed to speaking his mind, yet able to do so without giving offence, he was among the most popular of Air Force officers, and had a long and distinguished career in the Service, having transferred to the R.F.C. from the Highland Light Infantry in 1913 and having served with distinction in many fighting and administrative positions.

His influence in the Corps will be long remembered. Lady Mitchell in her bereavement can be assured of the sympathy of many thousands of officers and cadets who feel his death as a personal loss.


Air gunner, 1939, using camera gun


Hurricane, 1939—wooden airscrew


Halifax cockpit, 1943


Spitfire, 1943

Story of ACHIEVEMENT

by B. J. Hurren

FIVE years ago, at the beginning of the war, I was in France. A reminder of this arose recently in turning over some old papers which included a 15,000-word report of all that was then going on in "the phoney war."

What astonishing advances we have made in those interim years! Does it seem possible that we could ever have dared to go to war with such air power as then was ours to command?

Think of the famous warplanes which have passed into oblivion in the fret and fury of war! The Hampden, the Whitley, the Blenheim, the Battle and Fulmar, the Defiant, Skua and Roc, the Gladiator, the Lysander—though even these in small degree can be found in out-of-the-way zones. But perhaps even more remarkable still are those aircraft in the squadrons in 1939 and still in operation, though considerably "hotted up" in one way or another. There is the Spitfire, the Wellington, the Anson, the Swordfish, the Sunderland and the Walrus: all these were firmly established in the opening days of the war and are still going strong. Unquestionably many alterations and modifications have introduced radical changes in their fighting conception and actual performance; but it is indisputable that basically they are the same aircraft.

Most sensational development concerns the Spitfire. With Merlin engine its performance rose steeply as successive marks of Merlin were introduced (the Merlin has doubled its output during the course of the war!), and the Griffon Spitfire would leave the original Spitfire standing. Most unexpected manœuvre is the translation of the Walrus from shore naval duty with ships to the important ancillary role of Air/Sea Rescue. Longevity prize must be accorded the Swordfish, whilst the Wellington has appeared in a baffling number of guises.

In retrospect, British designers and constructors can feel a measure of pride in their achievements of yesterday. No other air service in the world has established such long-term warplanes of outstanding ability. Without odious comparison, the Germans can show only the Ju 87 in the longevity field, and the Americans have produced such a succession of aircraft that it is impossible to keep full track of them all—at least it would be extremely difficult to recall easily one American aircraft of 1939 that still shoulders war burdens in the same degree as the superlative Spitfire.

But there have been other changes of no less astonishing extent in these brief years of combat. It is not possible here to enumerate more than a small fraction of them, but it is of much interest to review a few.

Airscrews, for example! What changes there have been. The two-bladed airscrew has vanished from first-line aircraft, and we see more modern three- and four-blade airscrews with constant speed and de-icing equipment. More revolutionary still is the contra-rotating airscrew. In addition, whereas once the blades were made of aluminium alloy and steel, now Rotol, with its hidulignum-strengthened wood and other firms working on kindred plastic lines, have introduced something outside pre-war consideration.

No less a change has occurred in the world of undercarriages. The comparatively light affairs of yesterday have given place to huge pieces that dwarf a man and themselves weigh more than many light aircraft complete of the pre-war days.

An absolute revolution has also occurred in the gun-turret world. Few outside the industry can appreciate in full how great has been the advance here. It is, however, a fact that ten years ago there were not more than a mere handful of experimental turrets all told, and today there are tens of thousands. A new industry grew up almost overnight.

In the factories an achievement beyond all estimation has been accomplished. The pre-war principles of concentration and centralisation for mass production have been literally turned inside out. All Britain today is a vast arena of aircraft production. Dispersed as a precaution against concentrated bomb attacks are thousands upon thousands of factories, some as great as 10,000 hands, the majority small, whose grand output is channelled into the mighty flood of aircraft production for the R.A.F. and the Allies. Many of these units had no previous aircraft experience; today green labour in the shape of formerly untrained women is playing a part that certainly the German staff could never have appreciated before they decided on war.

No more startling advance has, however, been made than in the unobtrusive sphere of "aircraft standards." The Society of British Aircraft Constructors has today a total of more than 3,000 standards, all of which relieve the drawing-offices and designers of that much detail work. These standards are likely to play an all-important part in coming civil air operations on a world-wide basis. Nevertheless, do not forget that in 1939 the idea of standards was little more than an idea, a goal worth working for but seemingly then impossible of attaining.

Instead of looking back, suppose we look ahead? The technical development prospect is fascinating beyond belief. It might be too sweeping a statement to say that all of today's aircraft are obsolete already, but certainly the live wires of the aircraft industry are keenly aware of the vast scope for exploitation of some of the British inventions now passing rapidly beyond the initial experiment stage.

Who, for example, can gauge the measure of the jet-propulsion engine? I have seen serious arguments put forward for using a combination of airscrew driven by orthodox petrol unit and jet engine for turning on at altitudes above 30,000 feet: I have seen convincing arguments that such a combination would bring New York within two hours' flight of London at altitudes of 80,000 to 100,000 feet for most of the journey.

How will the giant aircraft of tomorrow operate? A key to this question may be in the British invention of the caterpillar undercarriage—similar basically to the military tank caterpillar track. Obviously such an idea, already up to its taxying stage of trials, presents new problems for the designer and enables, by spreading the load, the use of landplanes of 200 tons and more on surfaces hitherto unable to accept such loads for landing and take-off.

Behind all these and other developments I think a fundamental change has taken place in the aircraft world. The industry of today offers scope for youth, for ideas, for new ventures—especially in the radio world. Aircraft apprentices are placed in a new and improved position with better prospects by the Society of British Aircraft Constructors recommendations for training in aeronautical industry.

The change goes further than that. In the Royal Aero Club, for example, new fields are being surveyed, and the Club has under review the issue of a special flying certificate for helicopter pilots.

The rotaplane itself is one of the most baffling mysteries

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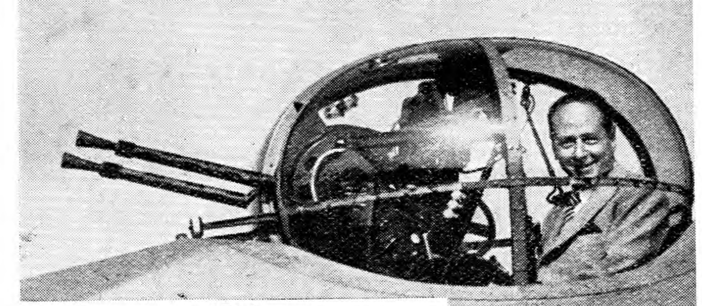
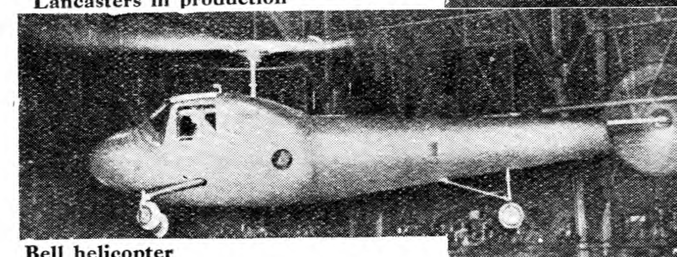
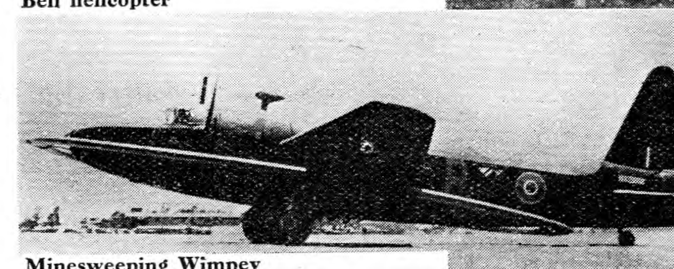

Lancaster turret, 1942


Lancasters in production


Bell helicopter


Minesweeping Wimpey


Tank-busting Hurricane

The Story of Achievement

CONTINUED FROM PAGE 3

of the future. Can its present difficulties be sufficiently mastered for the prospect of everyone flying by helicopter to come into practical shape? And if this occurs, as doubtless the technicians can soon bring about, how on earth is the vast flow of new air traffic to be controlled without wholesale accidents from collision?

Meanwhile, day and night in a special experimental shed somewhere in England there is an engine on test run non-stop. "It can't be broken and won't oblige by going wrong," said one of the technicians with a grin to me the other day. Elsewhere soaring and gliding experts are considering the possibility of installing a 10-h.p. motor to sailplanes which will be cheaper than the ordinary car. Remember, the whole story of aeronautical progress has hinged on engine development, and there may yet be sensational developments quite outside the jet propulsion favourite of today.

1939 . . . 1949. Ten dramatic years in our history. Tomorrow is the beacon for today's youth: but that means not only youth in years, but youthfulness in mind. It is refreshing to see how many of the great aviation names of 1939 are today still in the forefront of aviation pioneering. For the real asset of the industry is not so much the ephemeral and transitory successes of the present, but the abiding fact of widespread brains, intelligence and enterprise from the lowliest mechanic to the loftiest manager.

In parallel with this the R.A.F. is a young Service. It faces an illustrious future, because under the dire stresses of war it has shown itself adaptable beyond all preconceived notions. It was a daring resolution of the Air Staff to elect to build four-engined night bombers when the enemy did not pursue such a course. It was equally worthy of lucid appreciation of realities that when the time came Hurricanes were turned from air combat above 20,000 feet to ground strafing of Rommel's routes below 20 feet. Few Huns could have pictured the Wellingtons being used against the magnetic mine or the Tempest fighters against the fly-bombs.

These things, no more than a small part of the story, lie behind. The success gained in them augurs well for the future; and that future burns brightly, because the Air Age corresponds also with the age of youth, which, none better in the land, is typified by the A.T.C. of today and is itself a product of war.

The Rhodesian Air Training Corps

The Rhodesian A.T.C., which arose from the now extinct Air Section of the Southern Rhodesian Cadet Corps, was officially formed in May 1943. Its strength has not yet gone beyond the earlier number of about 200 cadets, but the population of the country is not very large, and those cadets who do undergo training are very keen.

There are about 80 State Schools in the Colony, and when the question of forming an Air Training Corps was first considered it was thought best to establish units only at those larger boys' public schools which already had a cadet corps. Seven of these schools and a Catholic school were invited to take part in the scheme, the training to be done during the normal cadet training periods. It was not possible to arrange for training during evenings and at week-ends.

These eight schools each have an A.T.C. unit affiliated to the nearest R.A.F. station. The cadets visit these stations regularly, and lectures and practical instruction are given by the R.A.F. officers and N.C.O.s in their spare time.

The first air cadet camp, which was held in August 1942, was arranged to show the cadets as much variety of training as possible, and although it was much enjoyed by the cadets, it was more in the nature of a "Cook's Tour" than a training camp, since five different R.A.F. stations were visited.

In August 1943 the cadets were taken to the R.A.F. station, Moffat, where they received thorough practical training on a competitive basis and had many opportunities for flying without interfering with the normal work of the station.

Each unit picked teams in map-reading, rifle-firing, gun-dismantling and assembly, aircraft recognition, signals, engine assembly and star identification, and units were also judged for smartness of tent lines, drill and marching.

Those cadets who were not in the teams, usually junior boys, had practical instruction in the subjects in which their teams were competing.

All units obtained over 70 per cent of the total marks in the tests, and as the tests were not easy this reflects great credit on the cadets and their instructors.

Rhodesian cadets need little instruction in rifle-firing. One cadet, aged 16, who was seen to obtain four bulls and an inner in quick succession in an "application" test was asked what practice he had with the .303 rifle. He said that his people had a farm in the wilds of Northern Rhodesia and that he often went out hunting game.

In addition to the cadets' training programme, the officers (schoolmasters) were given lectures on administration and acted as camp orderly officers in rotation.

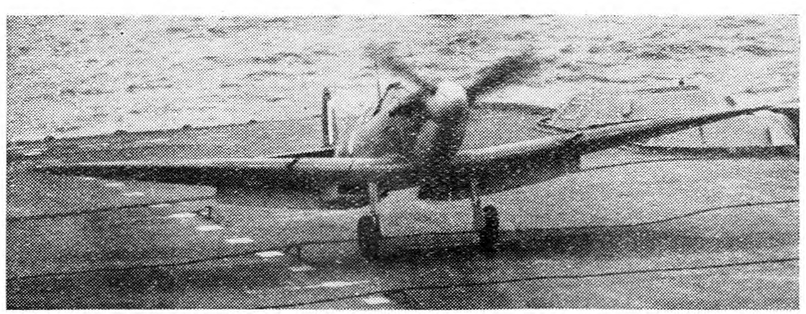
A.T.C. units in Rhodesia now have their own uniform, on Air Force lines, and Air Force ranks. A new training syllabus, on a three-year basis, is now in operation, and a third annual camp will be held this year in August, it is hoped with the same success as the last.

Australia wants A.T.C. for Defence after War

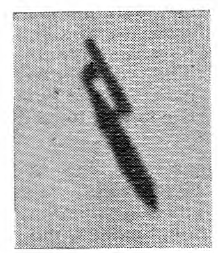
"The R.A.A.F. Air Training Corps should be retained after the war as a youth organisation, and the Citizens' Air Force re-established," says Wing Commander N. B. Love, commanding officer of the Corps No. 2 Wing, Sydney, Australia.

Wing Commander Love said that to help recruiting for the A.T.C. the Federal Government should give an assurance that the Corps will not be disbanded after the war.

"The British Government has given a useful lead by promising to continue the A.T.C. in Britain when the war ends," he said.



THAT the flying bomb is driven by a jet-propulsion unit is well known, but it does not appear to be generally realised what a very simple form of propulsion is the jet unit developed for this particular role by the Germans. It is necessary, when considering the pros and cons of this jet-propulsion unit, to remember that its requirements are very simple. Firstly, it should be able to run with a fair degree of reliability for, perhaps, up to an hour. Secondly, it should be cheap and simple to manufacture.



Diving.

The first requirement obviously assists the second in being met, and the resultant creation of the designer's mind is just what one might expect to be used for this particular function. There is nothing very brilliant about the design, unless it is the very simplicity of its conception. It is, in fact, the product of a mind used, for many years, to designing ingenious mechanisms for children's toys.

It would save our engine designers many headaches if we could make use of jet-propulsion units as simple as that in the Doodle-bug; but the R.A.F. usually have aircrews in their aircraft to ensure that the machine does its job properly, and this calls for a high degree of reliability on the part of the power unit. Another requirement, second only to reliability, is that the power unit shall be of high efficiency, that is, that it makes the very best use of the fuel supplied to it and at the same time is of light construction.

The Doodle-bug power unit is reasonably light, but it achieves this only through the simplicity of its construction, which results in a very poor efficiency. During normal flight it probably uses about one gallon per mile, which is more than the four engines of a Lancaster use during normal cruising. There is another reason why this simple form of jet-propulsion unit cannot be used for normal aircraft, but that will be explained when the working of the unit is discussed further on.

As is well known now, the principle of jet propulsion is that a stream of gas is ejected at great speed from the rear of the unit, and its reaction against the unit causes the aircraft to be propelled forward. In the case of the Doodle-bug the jet-propulsion unit consists, basically, of a combustion

Doodling.

chamber into which the air, due to the forward motion of the aircraft, flows. The air flows into this chamber through shutters at the front of the nacelle that houses the unit. The shutters in the static condition are kept shut by spring-loading, but the forward speed of the aircraft gives the air enough thrust to open them. Inside the chamber there is a form of sparking plug and a fuel injector, or a number of injectors. This injector sprays, periodically, a considerable amount of fuel, which mixes with the air passing through the chamber. The sparking plug flashes just a fraction of a second after the fuel has been injected, and causes rapid burning of the air and fuel mixture. The resultant explosion naturally causes a very sharp rise in pressure, and the burning mixture rushes out of the back of the chamber, to impart to the aircraft a thrust forward. There is probably a venturi, or narrow section, at the outlet from the chamber, provided to increase the speed of the burning gas as it leaves the aircraft. When the explosion takes place the back pressure in the chamber will have shut the shutters against the incoming air, but as soon as the burning has expended itself the pressure of the air at the front of the nacelle will reopen the shutters and the cycle will commence once more.

In flight the Doodle-bug appears to eject a continuous flame, but a photographic time exposure of the machine in flight at night will show a series of light dots marking the course of flight. The photographic plate is, of course, only sensitive enough to record the most intense area of burning, whereas the human eye records what is apparently a continuous flame. This intermittent burning must cause very distinct impulses to the forward motion of the aircraft, and this is the reason, mentioned earlier, why this unit could not be used to propel orthodox aircraft—the crew would find the intermittent thrust most uncomfortable.

The Doodle-bug has to rely on forward motion of the aircraft to operate the unit, and therefore some means of catapulting at the commencement of the flight is necessary.

This Month's Cover

The front cover shows the tail unit of the B-29 Superfortress, the latest heavy bomber in service with the U.S. Army Air Force, beside a development of the Culver Cadet. The two have one thing in common—a tricycle undercarriage. The span of the Cadet is 26 ft. 11 in., while that of the B-29 is 141 ft. 3 in. The back cover is a Typhoon receiving its cooky. Although most Tiffys are fitted with rockets, many of the bomber versions are still in service and doing great work in France. Like the Mosquito, the Typhoon has proved to be one of the most outstanding types of the war; versatility, robustness and good hitting power are only a few of the characteristics of this worthy member of the Hawker family.

The inside back cover has a striking picture of the Martin Baltimore medium bomber. The aircraft is shown winging its way home across the Adriatic after a raid on German-held Yugoslavia.

Fighter Escort

by 'STRINGBAG'

REHEARSING TACTICS FOR THE PACIFIC BATTLE

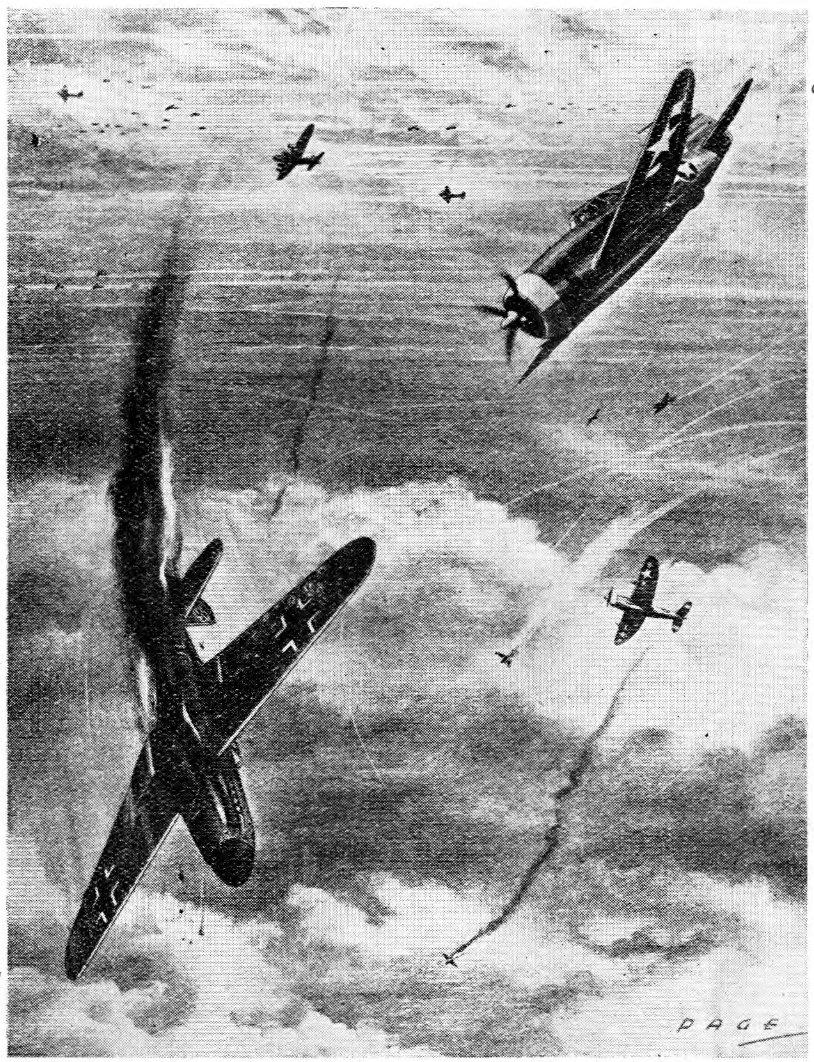
THE operations board was covered by a mass of figures, letters and names. It was as if the great cricket score-board at the Oval had got into the hands of a mathematician with a fancy for permutations. It was incomprehensible to the casual eye, yet to the pilots and observers who gathered round the story it told was as simple as the one you might tell to the children before they go to bed. A few hours later the same story might have been crystallised in a few sentences on a sub-editor's desk in a great newspaper office. They would have conveyed the news that a strike of Barracudas covered by naval fighters had dive-bombed and sunk an enemy warship.

We've heard that story before and glowed with pleasure. But we have often forgotten the very much more involved story which lay behind it—the preliminaries on the operations board, which for its mass of figures and letters is bewildering and complex. We are prone to forget that a simple strike by a mass force of dive bombers with mass fighter cover is the outcome of wonderful timing and organisation.

Action

Ninety minutes after standing in front of that operations board I was at a point some 3,000 feet above a rock standing off the coast, while down below the camouflaged streaks of Seafires whipped in from two directions, churning the sea about the rock with their cannon fire, while from up above—from some 8,000 feet— the slim shapes of Barracudas came screaming down in an almost vertical dive on to the same rock. The white puffs of their exploding bombs were the end of the story.

Artist's impression of Thunderbolts escorting Fortresses.



I had been waiting up there for just this to happen. As the hands of my wrist-watch crept nearer to 1200 I began to do tight figures of eight close to the rock, searching the sky above for the first signs of the strike, and at the same time trying to discover the shapes of the Seafires coming in off the land at zero feet, weaving between the hills, and then flashing like miniature thunderbolts across the water to their target. At one minute past 12 the first wave of Seafires suddenly sprang out of their dark background. The operation was a minute late.

The Outward Journey

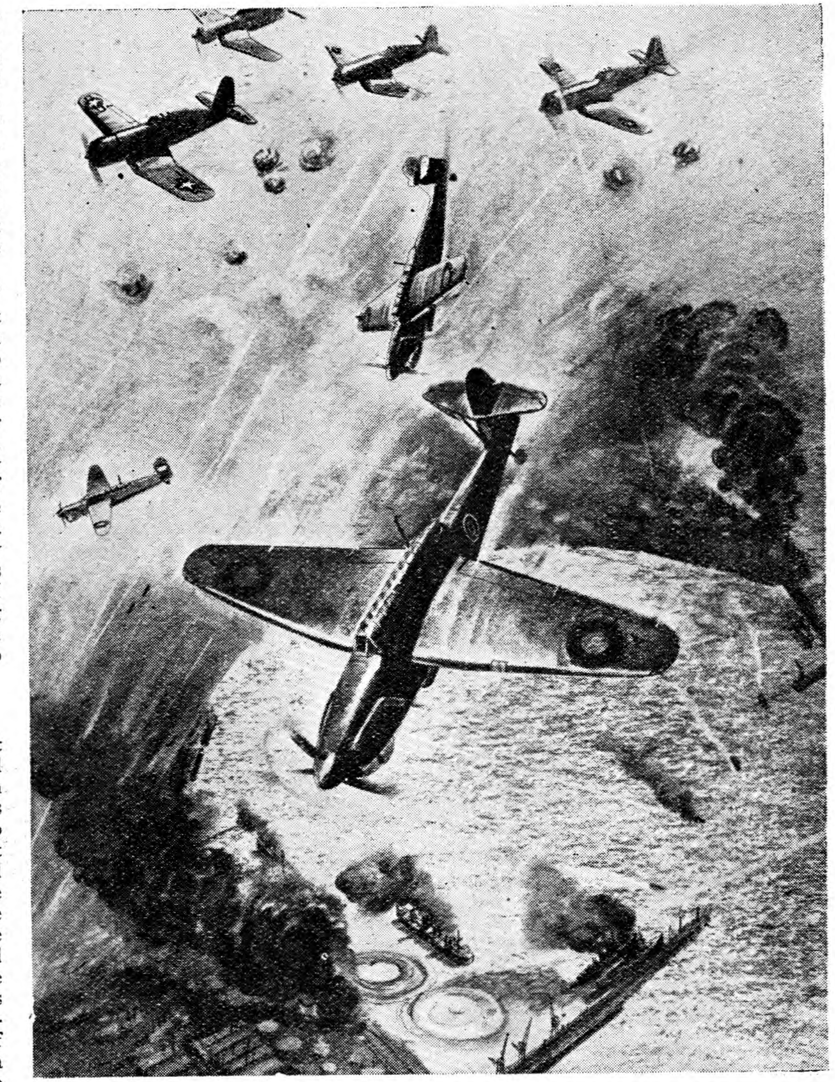
One minute is a fair margin of error considering what had happened beforehand. To start with, the whole force had already flown three tracks which had taken them half-way across England. The dive bombers had gone off first. The pilots had pressed their engine-starter tits at exactly 1100, and at 1110 they had been a dark umbrella of aircraft in tight formation, swinging on to their first course while they continued to climb. They disappeared into a grey background of cloud lying thick above the wild country towards the east.

Thirty-one minutes later they had been met by the Seafires which were to cover their attack. This was somewhere out over the middle of England, miles from the sea which they had left. They met within 30 seconds at the rendezvous, between layers of cloud at 6,000 feet, the fighters splitting into top and medium cover, perpetually weaving over their charges, flying at high speed in case they were "jumped."

Mixing It

Then a squadron of "enemy" Corsairs had come in to intercept, travelling at perhaps 400 m.p.h. down the cloud-mountains of the sky. The R/T, which had been silent until that moment, crackled as they were seen by the leader of Yellow section. The observers in the dive-bombing force looked backwards, mouthpieces to their lips, to warn their pilots. The wing leader had his microphone switched to transmit, and watched and waited as the American-built fighters hurtled down.

Then the sky had suddenly seemed filled with aerobating aircraft. Seafires shooting vertically upwards, rolling down, with thousands of feet air space consumed in a few seconds, and creating utter turmoil without order or formation. And yet in a few seconds the attackers had broken away, and there were the Barracudas once more, still in perfect formation, still at 6,000 feet and still nearer to their target. They had swept down and up, corkscrewing like a single unit in special evasive tactics, swinging just so much one way and then the other, so that their true course towards the objective was maintained.



Artist's impression of Corsairs escorting Barracudas during an attack on the Japanese base at Sabang, Sumatra.

Five times they had been "jumped" by the Corsairs, and hundreds of feet of ciné film had been exposed by both attackers and defenders for analysis to show how many among that armada got through. The film was taken at the moment the fighter and dive-bomber pilots had pressed the tits of their guns. showed the angle of deflection they had allowed, the range and the line of flight . . . the exact place where the cannon shells had hit or missed. As a result of it one would be able to say whether or not that strike reached its target. As for the final attack itself, I had myself seen the plume of bursting bombs rising like gay feathers from that rock off the coast. There was no doubt about that.

Thinking Big

Wing tactics like these are the result of the mammoth growth of the naval air war. When a job was to be done in the past its planners thought in terms of a single carrier—or perhaps two carriers, if they could be spared. So it was that the *Bismarck* was hunted through the stormy wastes of the Atlantic by the *Ark Royal* from the south and the *Victorious* from the north, and the Italian Fleet assaulted and crippled at Taranto by a mere handful of 22 Swordfish and Albacores from the *Illustrious*. Today the planners think in terms of a whole fleet of carriers, themselves protected by a massive array of armour from the capital ships, cruisers and escorting destroyers.

Timing

Britain's carrier fleet, like America's, has grown and grown. It has meant the handling of scores of aircraft on each operation, the development of new tactics and the constant practice of them at the fighter schools. The timing of each "swarm"—for that is what they have become—is technically difficult and yet tactically vital. As I watched this particular strike develop as the Navy's Air Combat School, I could see the lessons unfolding below me. Those straffing Seafires should have been about 30 seconds later, for they were away while the Barracudas were not half-way down in their dive. Alternatively, the Barracudas might have come down 30 seconds earlier—but I saw up there that a pair of "enemy" Corsairs was giving them hell and upsetting the timing. Moreover, in the wild hurly-burly of the last few seconds, when the sky was full of defenders and attackers, the Barracuda wing leader hung on four or five seconds too long before commencing his dive. It meant a sensationally steep approach and several clutches of bombs over the target.

Practice Makes Perfect

And yet the drill I had seen was marvellously impressive. To get a whole strike of Barracudas manœuvring as a single aircraft in evasive tactics was in itself something which would have been regarded as quite brilliant at a pre-war Service flying display. The accuracy of the navigation under cloudy conditions to within a couple of miles of the target and within one minute of zero hour was satisfactory. The combat film of the fighters showed some fine shooting from extremely difficult angles, including a couple of downward twizzles by the high fighter cover which riddled a pair of Corsairs.

Today they'll do it again. The enemy will spring new surprises, the operations board will be still more complicated, the timing will be for narrower margins. Pilots and observers, already thinking in terms of stop-watches and minute intervals, will be learning to work to seconds until an operation goes like a chorus routine on the stage. Every possible trick by the enemy will be tried and combated. Then one day, when the gun buttons are pressed instead of the camera buttons, and the scene is the Pacific instead of the English counties, each pilot and observer must have the feeling of having fought this very battle before, and because he has already practised it so often he will win it.

Airspeed Aircraft

by **R. G. WORCESTER**

The progress of Airspeed Ltd., of Portsmouth, now a branch of the de Havilland Company

The Tern

AIRSPEED LTD. was founded by A. Hessell Tiltman and N. S. Norway in York. The first machine they built was the Tern single-seater high-performance sailplane of wooden construction. The flat-sided fuselage was built of spruce longerons and transverse frames with exterior covered with three-plywood. The Terns have done well. Mr. G. A. Little, among others, is one of the owner pilots who obtained a Silver C gliding licence in his Tern.

The Ferry

The three-engined Ferry made its first appearance soon after the Tern, and was powered with Gipsy engines, the centre one inverted to allow airscrew clearance over the fuselage top. Provision was made for eight to ten passengers. Six Ferrys did good work, particularly with the Flying Circuses. They were designed for economical operation of good payloads over short distances.

The Courier

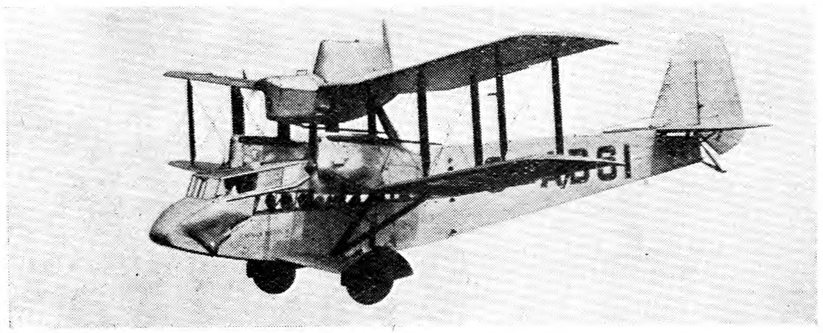
In 1934 the firm moved from York to Portsmouth, and the first machine from the new factory was the fast and modern Courier transport. The design was quite the most advanced in the country at the time. A 240-h.p. Armstrong-Siddeley Lynx IVc seven-cylinder radial engine was fitted on a tubular-steel welded engine-mounting, with the crankcase faired in; only the cylinder heads projected, and were covered with a Townend ring. The exhaust-collector ring was let into the engine cowling. The four-longeron fuselage was of wooden semi-monocoque construction, with ply laid with 45-degrees-angle grain.

The five-seater Courier, with facilities for dual control, was an immediate success. Later the engine was changed to the more powerful Cheetah V, driving a metal Fairey-Reed airscrew, giving a cruising speed of 140 m.p.h. An experimental Courier was fitted with a 16-cylinder Napier Rapier engine with four-bladed wooden airscrew.

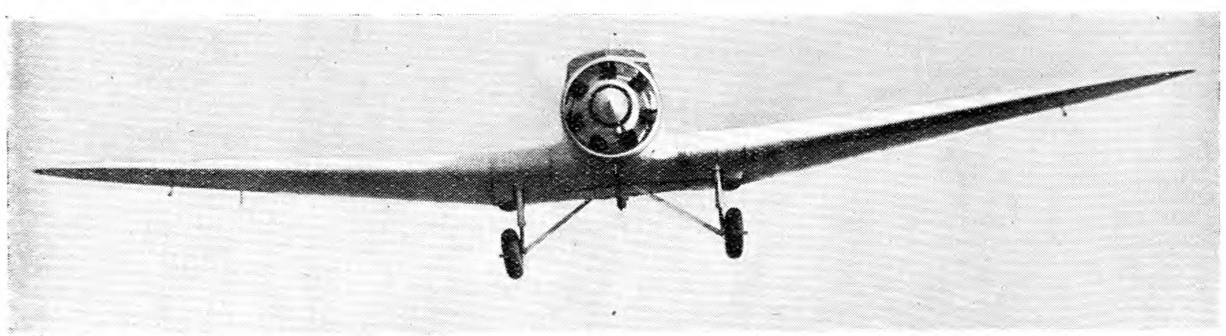
The Envoy

In the same year (1934) the first Envoy was finished, which was, in effect, a twin-engined Courier. Powered by two Wolseley AR9 engines with Townend rings and driving either wooden or Hamilton V.P. airscrews, with cabin arrangement for six to eight seats (an alternative luxury four-seat arrangement was available). The fuselage, tailplane, undercarriage and extension planes were all the same construction as the Courier. The centre section differed by being extended to take the twin motors, fuel tanks, undercarriage assembly units and leading-edge oil tanks. The engines later were altered to the Lynx, followed by Cheetah Vs (this latter was called the Viceroy). The 350-h.p. Cheetah IX was finally fitted as standard equipment, with helmet cowlings giving a maximum speed of 205 m.p.h. Envoys were used on the Moscow-Prague run of the Czech State Airlines, fitted with Czech Walter Castor II radials driving metal adjustable-pitch Letov airscrews. South African Airlines bought six Convertible Envoys (the Convertible Envoy had provision for fitting of bomb racks and dorsal turret in a few hours). C.N.A.C. in China ordered two Envoys, and they were flown out there by G. B. S. Errington and the late Flt. Lieut. C. H. A. Colman. Other Envoys were privately owned in India, Australia, the Far East, as well as at home. The Envoy was developed into the series II and series III, which incorporated split trailing-edge alloy flaps in five sections operated from the undercarriage hydraulic system, ply-covered stressed-skin wings and metal ailerons.

G-AEXX, the finest Envoy ever built, was delivered to the Air Council for use in the King's Flight, and carried His Majesty on a tour of R.A.F. stations.



The Ferry.

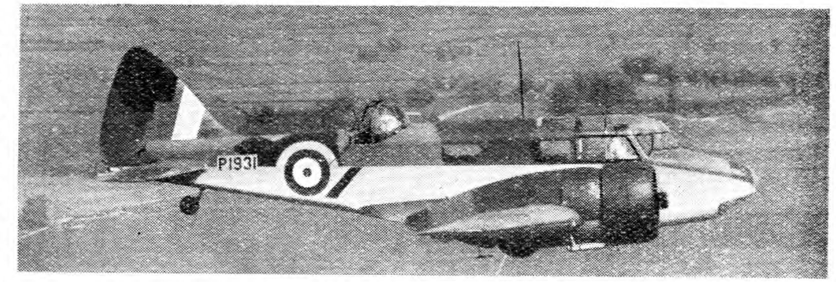


The Courier.

The Oxford

The A.S.10, later known as the Oxford, was developed directly from the Envoy, but was much more robustly built to stand up to Service training conditions, and so none of the parts were interchangeable. The Oxford has for years been the standard R.A.F. twin-engined trainer, and is used in the Middle East, New Zealand (where it has broken some flying records), Canada and elsewhere in the Empire training scheme, as well as on a vast scale in this country. Besides the pilot's training, there is provision for wireless, bomb-aiming and air-to-air firing practice. The Oxford fuselage differs from the Envoy, with its side-by-side dual control and manually operated turret in the rear fuselage. The centre section is reversed to contain a bomb bay to accommodate light series practice bombs. The Mk. II Oxford is used only for pilots' training, and later Oxfords have been fitted up as ambulances. The Oxford has the familiar high fin and rudder, the wings are ply covered and are much stronger altogether. The undercarriage is similar to the Envoy, except it is heavier, with twin oleo legs made by Lockheed.

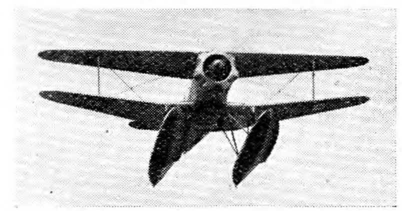
The power is by two 375-h.p. Armstrong-Siddeley Cheetah Xs, an engine developed from the Cheetah IX specially for the Oxford, and incorporating a pump to drive the flaps and undercarriage, and V.P. airscrews or wooden, metal or plastic blades. Oxfords have been introduced with American engines and also Gipsy in-line engines. The Cheetah X Oxford has a top speed of 192 m.p.h.



The Oxford.

The Queen Wasp

In 1937 the prototype Oxford and Queen Wasp flew for the first time in the same week in the hands of test pilot the late Flt. Lieut. Colman. The German flying bombs remind us that the Wasp, powered with a Cheetah IX engine was built as a radio controlled target machine fitted with either Short-built floats or a fixed, spatted undercarriage. The wings were made of wood, with single-bay biplane arrangement and sharp dihedral on the lower mainplanes. The fuselage of wooden spruce longeron construction was ply covered and had provision for a pilot and one passenger. Production of the Wasp was started, but discontinued when Hitler started providing all the targets that our A.A. gunners were likely to require.



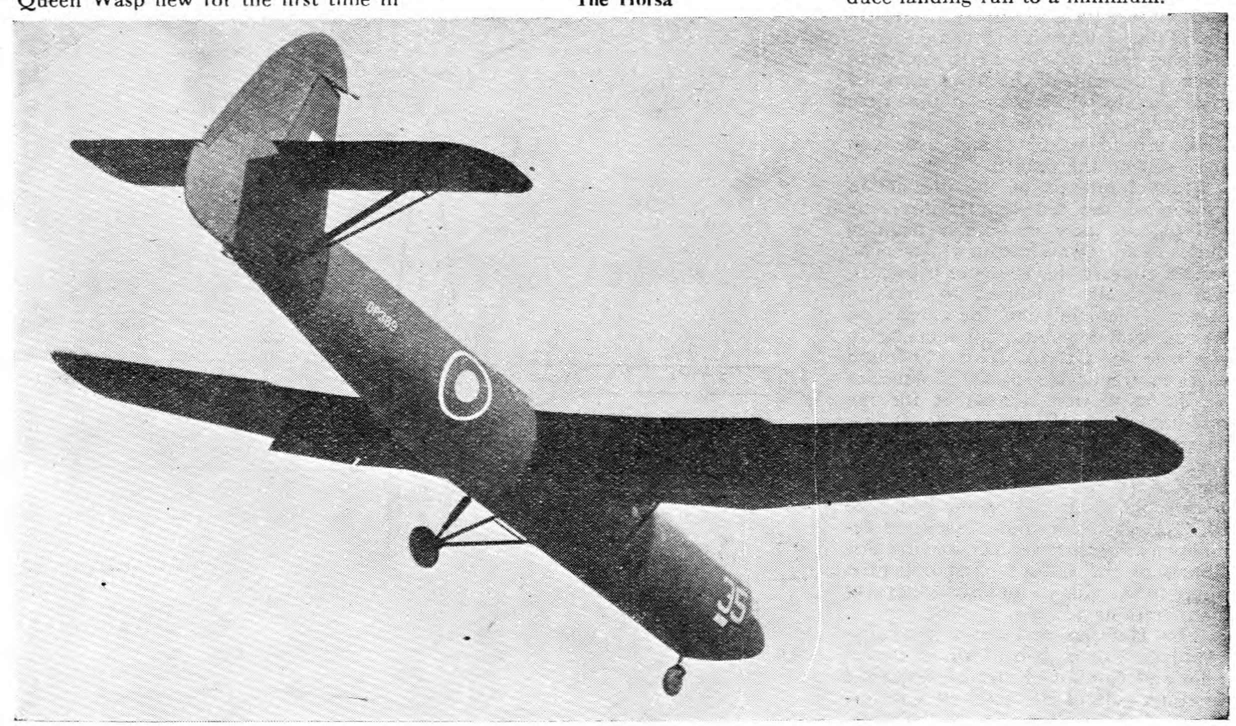
Queen Wasp.
[By courtesy of *The Aeroplane*.

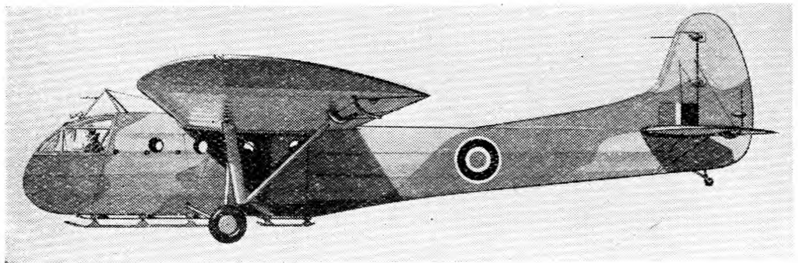
The Horsa

The Horsa heavy glider, towed by Dakota, Halifax, Whitley, Albemarle, Stirling and other aircraft, has made a dramatic appearance in Normandy. Its huge fuselage accommodates a variety of different military loads, including paratroops, jeeps and stores of all kinds. The cylindrical fuselage is built in three sections: the cockpit assembly, the main body, and the rear fuselage tapering to the braced tailplane, fin and rudder, with rear skid. Formers run the length of the fuselage, and interspaced with circular hoops, all covered with stressed-skin ply. The rear fuselage is detachable to facilitate unloading. The mainplanes are of wooden box spar and spruce rib construction, also the tailplane assembly. The cockpit has provision for first and second pilots; between them is the instrument panel and release gear. The tow-rope is attached to a strong point on each wind undersurface.

The undercarriage comprises a fixed nosewheel, and two mainwheels which can be jettisoned after take-off, leaving a laminated ash skid for the landing. The trailing-edge flaps are used to regulate the glide approach. They are operated by a pneumatic system and air bottle. With full flap a very steep angle of approach can be used to reduce landing-run to a minimum.

The Horsa





The Waco Hadrian I

THE CG-4A, or Hadrian I, has already received its baptism of fire during the landings in Sicily, and made aviation history when the glider "Voo-Doo," piloted by Squadn. Ldr. R. G. Seys, D.F.C., and Squadn. Ldr. Gobeil made the first crossing of the Atlantic by towed glider. The "Voo-Doo," with $1\frac{1}{2}$ tons of supplies for Russia aboard, covered the 3,500 miles from Canada in 28 hours flying-time, an average speed of 125 m.p.h.

During April 1941 the U.S. Army authorities placed an order with the Waco Aircraft Company for a nine-seat training glider and a 15-seat troop-carrying and transport glider. A. Francis Arcier, Waco's chief engineer, had completed his designs for the two aircraft by November of the same year, and production was started on what was intended to be the standard equipment, both trainer and operational, of the American glider-borne regiments. The company was not without experience of glider construction, since during the early nineteen-thirties the Troy factory produced a small sporting glider, the FHB, to meet the requirements of the many amateur gliding clubs which were at that time springing up all over the States. The FHB proved popular, and over 300 were sold to the public.

Many hundreds of the production version of the nine-seat trainer, the CG-3A, are now on similar training duties as our own Hotspur glider. The second aircraft, the 15-seater transport, was originally intended to have a larger accommodation for cargo and troops, with a substantial increase in size over the CG-3A. This was found to be impracticable, as the dimensions of the type were too great for the building space allotted to it. It was therefore decided to increase the cabin space as much as possible while keeping the overall dimensions within a reasonable limit. A prototype, the XCG-4, was built, and after some development was accepted for the Air Forces as the CG-4A, first deliveries going to the glider and airborne operations training schools.

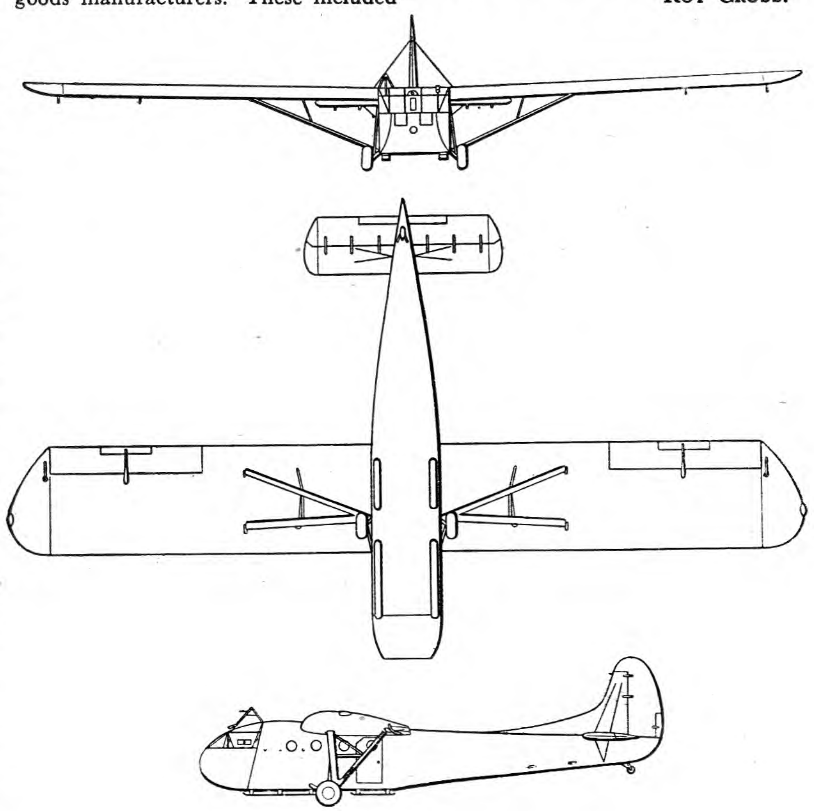
The Hadrian will carry 15 fully-equipped troops, two of whom act as pilot and co-pilot. Entrance doors are in either side of the fuselage just forward of the trailing-edge of the wing, while for the loading of bulk freight the entire nose compartment hinges upwards.

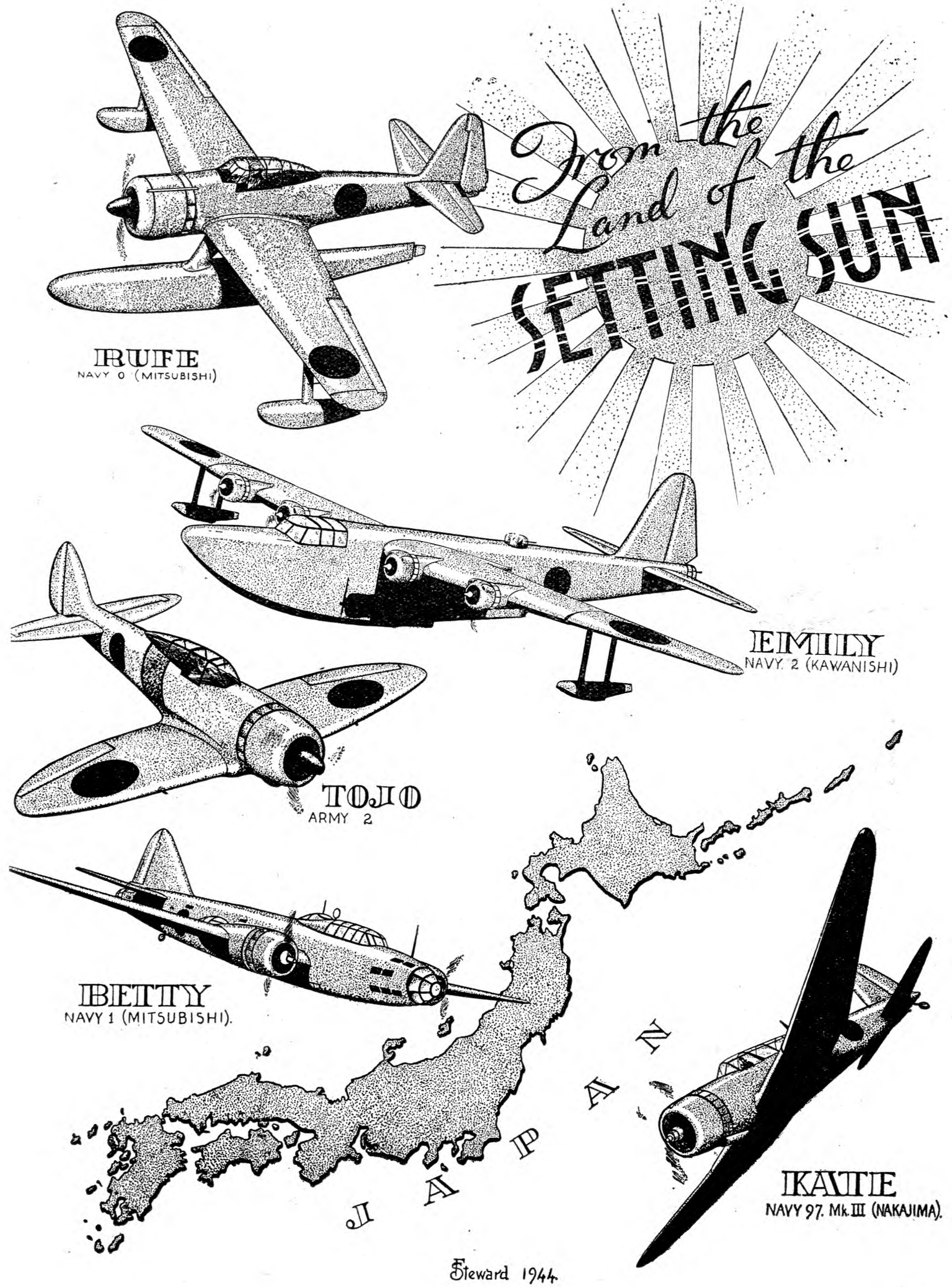
Equipment includes full blind-flying instruments, oxygen gear and air/air portable "walkie talkie" radio. The undercarriage may be jettisoned to allow a landing on rough ground, during which the alighting shocks are partly absorbed by four skids attached direct to the bottom longeron. Molybdenum-steel tubing is used for the fuselage structure. The two-spar wing and the tail unit are of wood. Fabric covering is employed throughout.

Such large initial orders were placed for the Hadrian that the available production facilities at the Waco factory had to be supplemented by a large sub-contract programme involving 14 other aircraft and wooden-goods manufacturers. These included Boeing, Beech and Cessna at Wichita, Kansas, and the Ford works at Iron Mountain, Michigan. This latter plant has now received a seventeen-million-dollar contract to build the new Waco CG-13, enlarged version of the CG-4. The CG-13 has passed all tests, and is in full production at the Northwestern Aeronautical Corp. plant, Minneapolis, as well as the Ford works.

The first two types in the new U.S.A.A.F. PG (powered glider) class are CG-4As fitted with a pair of light engines. They are the PG-1 (two Franklin GAC-298-F3 130-h.p. motors) and the PG-2 (two 175-h.p. Ranger motors). The motors were originally installed so that the gliders could make the delivery flight under their own power. This saved the trouble of dismantling and crating the aircraft for dispatch. The engines were readily removable on arrival at the destination, and were flown back to base to be used again. The scheme, originated by Northwestern engineers at Wright Field, was such a success that the PG category was created, and the powered CG-4As are now employed on general transport work. It is interesting to speculate just what scope there would be in the post-war civil aviation world for aircraft of this type. As a cargo and frieght-carrier for short hauls it should prove economical to operate and maintain. Low initial cost and ease of manufacture would be added attractions. It would truly become the "flying box-car" of the airways.

ROY CROSS.





Coastal Command

By AIR CHIEF MARSHAL SIR SHOLTO DOUGLAS, K.C.B., M.C., D.F.C.

The work of Coastal Command described by its Commander-in-Chief

THE first and most important job of Coastal Command is to counter the German threat to starve Britain out of the war by intensive U-boat operations against her lifeline—the ships that bring from America and the Empire food for the people, and men and materials to wage war. Without these cargoes Britain could not have carried on through the five years of war; and the Allies could not have built up the immense force of men and equipment that is now being shipped over to the Continent for the assault upon Europe. Without the protection afforded by the aircraft of Coastal Command, co-operating with the surface craft of the Royal Navy, very few of these ships would have been able to penetrate the U-boat net and reach the shores of Britain.

At the outbreak of war the Command had few aircraft, most of them obsolete types—Ansons, London and Stranraer flying-boats, backed by a few Sunderlands and Hudsons. Their range was limited. Convoys could be escorted only on the last three or four hundred miles of their voyage, and there was a gap in the Atlantic through which ships had to pass without air protection. U-boats hunting in packs in this area took a heavy toll of our merchantmen. The aim of Coastal Command, therefore, was to extend the range of operations so as to narrow the gap and eventually to close it.

The first step was the occupation of Iceland, which gave the Command a midway base from which Battles, Northrop seaplanes, and later Sunderlands, Hudsons and Catalinas patrolled the northern sea routes.

Then gradually the Command obtained aircraft with better performance. Whitleys and Wellingtons replaced the Battles and Ansons, and patrols were extended further across the Atlantic. But there was still a large gap, and the U-boats there continued to operate free from air attack.

With the introduction in increasing numbers of long-range aircraft—Halifaxes, Fortresses and Liberators—the offensive against the U-boat developed; and in March 1943 Liberators fitted with special long-range tanks, linking up with Royal Canadian Air Force Aircraft from Newfoundland, bridged the gap. Based on Iceland, Northern Ireland and Britain, these aircraft were able to provide air cover over the whole of the North Atlantic. Improved radar devices opened up their field of contact, and the introduction of the Leigh light enabled them to continue their hunts by night as well as by day.

Beating the U-Boat

With this increasing offensive power the Command continued to carry out

CONTINUED ON PAGE 17

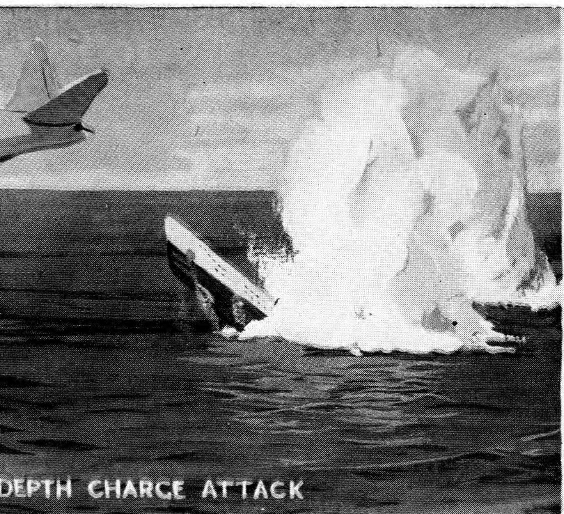
COASTAL COMMAND AIRCRAFT

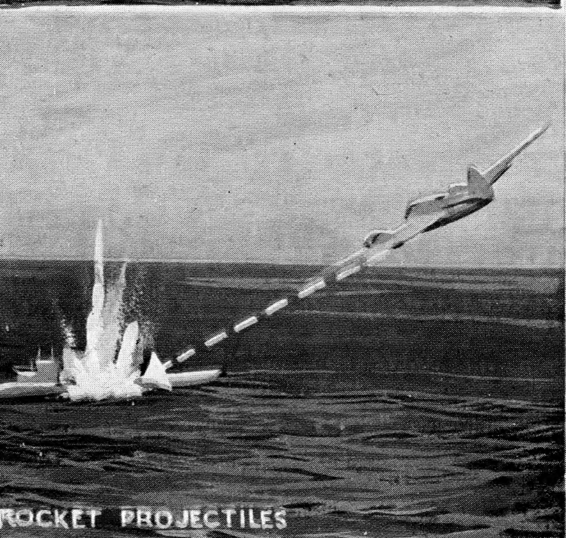
SUB HUNTING

by W. Megoran

In the early days of the war complete subjugation of the U-boat was of the first importance. It seemed evident that, as in the last war, the final blows against the enemy would be enfeebled and delayed if immediate counter-measures were not quickly developed. Working in close conjunction with the Navy, Coastal Command has therefore developed the maximum energy and skill in patrolling the sea lanes, altering her tactics to suit the varying modes of attack, and training and equipping her air-crews for a special type of air warfare, totally different from any other in the R.A.F. Whilst anti-submarine bombs and cannon shells are also used with good effect the depth charge still remains the most lethal, its power and effects are illustrated in the drawings below.

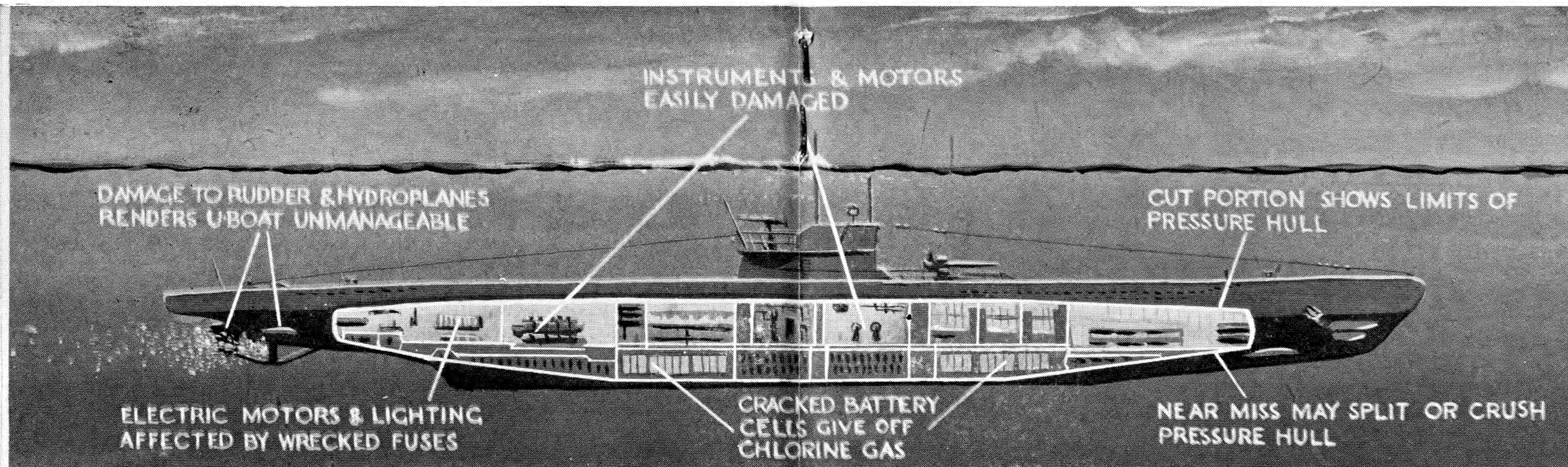
ATTACKING THE U-BOAT

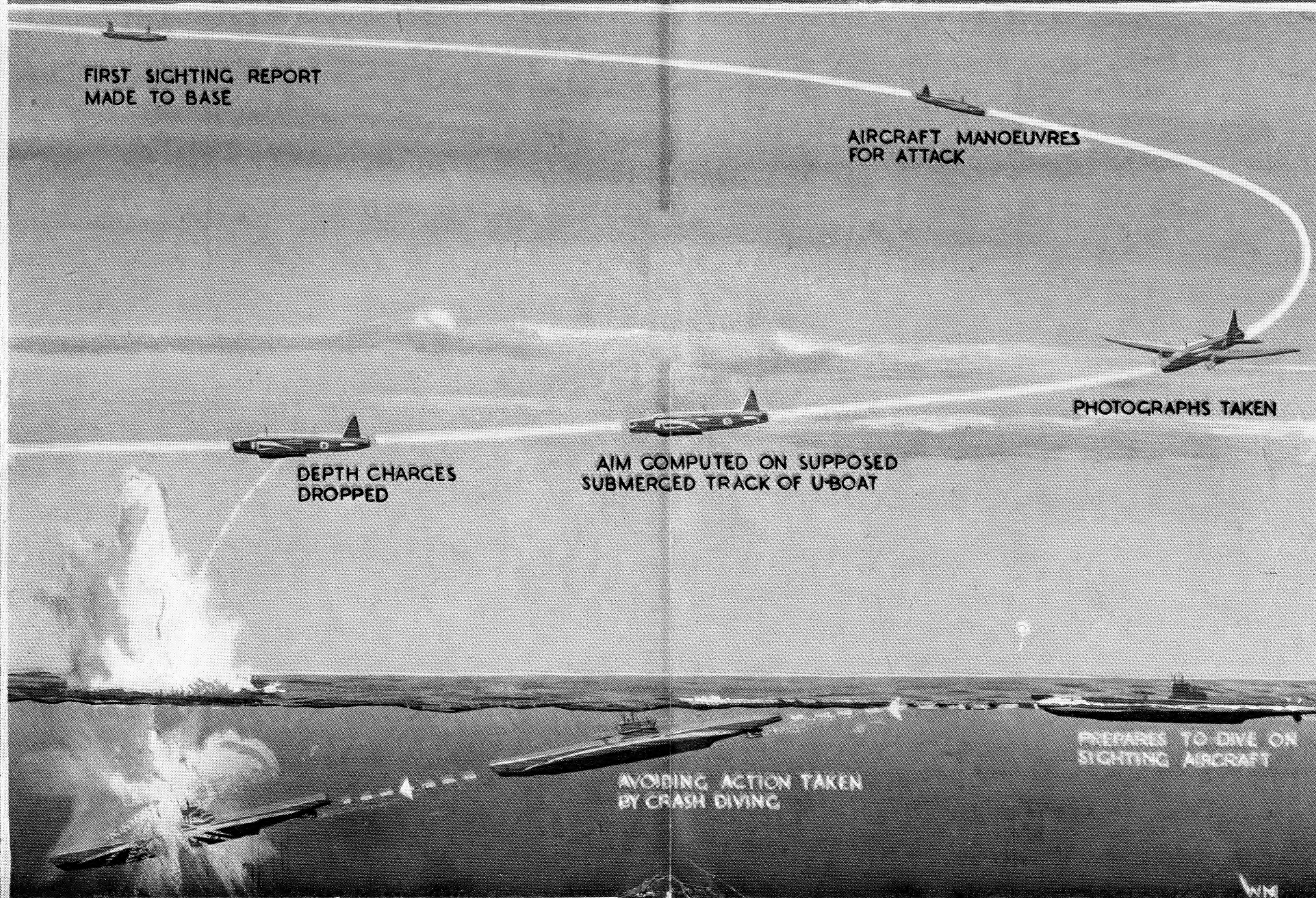

DEPTH CHARGE ATTACK


ROCKET PROJECTILES

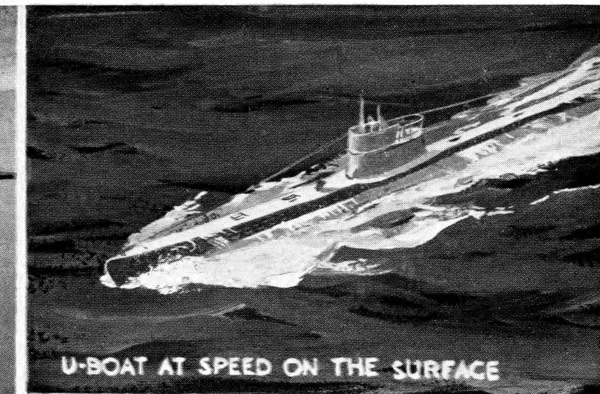

ATTACK ON BASES & YARDS

DAMAGE AND DESTRUCTION BY DEPTH CHARGE



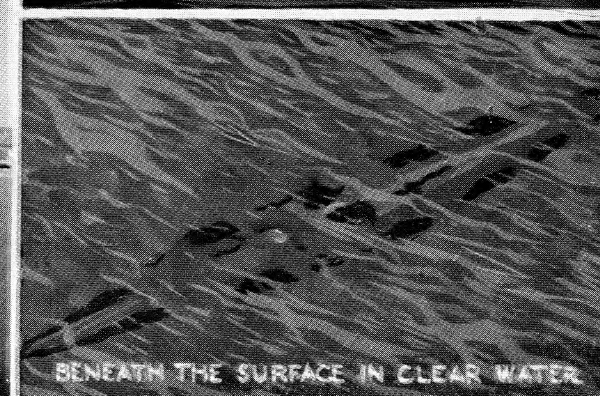


RECOGNITION FROM THE AIR


U-BOAT AT SPEED ON THE SURFACE


SWIRL LEFT BY DIVING U-BOAT


PERISCOPE FEATHER


BENEATH THE SURFACE IN CLEAR WATER

Coastal Command

CONTINUED FROM PAGE 12

convoy protection patrols in the Atlantic, but the main theatre of operations moved from the Atlantic shipping routes into the Bay of Biscay area. The second great battle of Coastal Command began—hunting and killing U-boats as they came out of and returned to their pens in the French Atlantic ports. The plan followed for this offensive provided a dense and regular patrol through which U-boats could not proceed without surfacing at some stage to recharge their batteries. The enemy tried various tactics to evade our patrols. They began by surfacing only at night, but increasing kills by Leigh-light aircraft made this too costly. They then improved the A.A. defences on U-boats and attempted to negotiate the patrol area on the surface in groups; but attacks by aircraft and naval escort groups increased, and the numbers of U-boats that slipped through to the Atlantic decreased. The enemy tried to break the anti-U-boat screen by basing fighters on the Brest Peninsula, but fighter sweeps with Beaufighters and later Mosquitoes dealt effectively with the Ju 88s.

Safeguarding Convoys

An all-out offensive was maintained until just before the Allied invasion of the Continent, when Coastal Command had to tackle the job of safeguarding the invasion convoys crossing the Channel. The plan in this case was roughly the same as for the Bay offensive—a dense patrol operating across the mouth of the English Channel. This battle is still going on, as the aircraft cover many thousands of square miles in their unceasing effort to "hold the ring" against the U-boats, and co-operate with the Navy in sinking or damaging any that attempt to break through into the Channel.

So far I have concentrated on the anti-U-boat aspect of Coastal Command, because that is its primary function. But side by side with the development of the anti-U-boat offensive, the Command carries out other important roles. Anti-shipping strikes, photographic reconnaissance, meteorological flights and air/sea rescue operations also come within the scope of Coastal Command.

Attacks on Enemy Shipping

On the anti-shipping side, squadrons of Mosquitoes, Beaufighters, Albacores and Wellingtons have been keeping up attacks by day and by night against enemy shipping operating off the coasts of Norway, Holland, Belgium and France, enforcing the blockade on the enemy by harrying and destroying his coastal craft, blockade runners, escort vessels and minesweepers. Armed with torpedoes, rockets, cannon and bombs, these Strike Squadrons of the Command have been taking an increasingly heavy toll of the enemy's limited fleet of coastal craft. Reinforced by Fleet Air Arm Squadrons of Swordfish and Avengers, they have in the weeks preceding and since the invasion dealt severe blows against the E-boats and R-boats which attempted to interfere with the Allied cross-Channel shipping.

Reconnaissance

Reconnaissance has always been one of the primary functions of the Command. In the early days of the war Sunderlands and Hudsons made frequent reconnaissance flights over vast stretches of sea, searching for, shadowing and attacking enemy vessels; flying over the Norwegian coast seeking out enemy naval units skulking in the deep fjords and reporting their attempts to leave safe waters. Later, with the increasing bomber offensives over enemy-occupied territory in Europe, high-altitude Spitfires and Mosquitoes make long flights into the heart of the enemy's territory, bringing back photographs of targets to guide our bombers and photographic evidence of results of raids to enable damage assessments to be made.

Meteorology

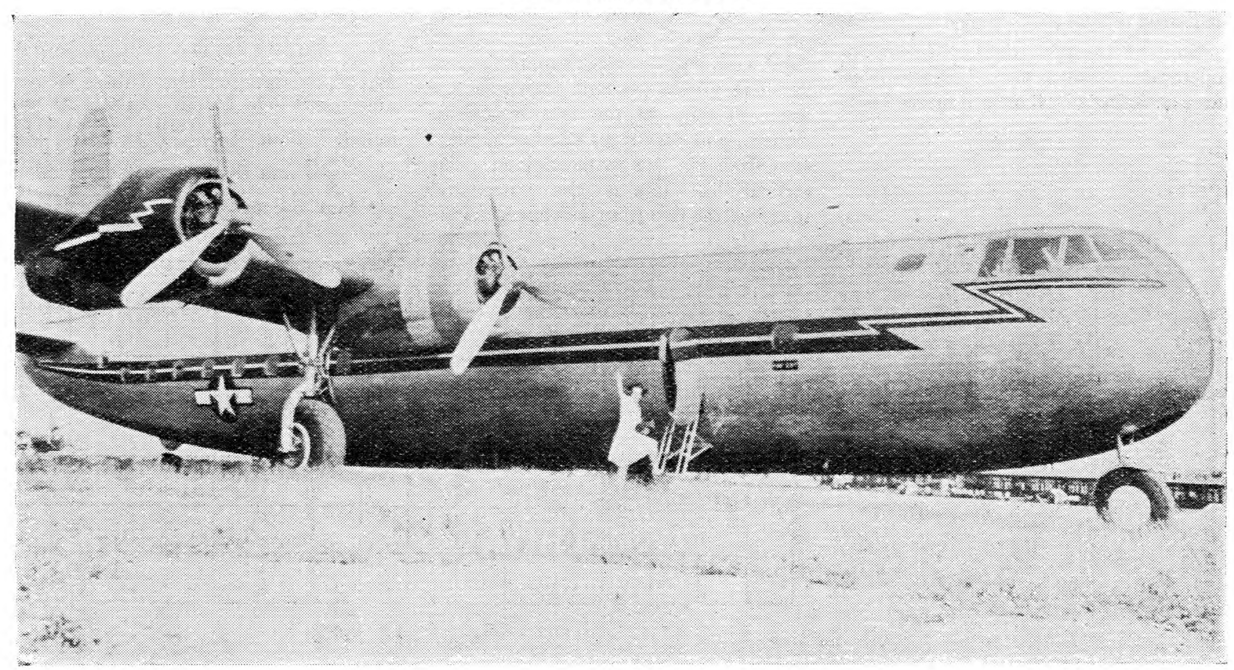
The Meteorological Squadrons of Coastal Command perform one of the most tedious and arduous of flying duties. Halifaxes, Hudsons and other aircraft carry out long, tiring patrols, with no promise of enemy action to stir them; noting and reporting weather conditions from the Arctic to the Equator.

Rescue

Air/Sea Rescue is the Royal Air Force's flying "life-saving" service. Specialised Hudson and Warwick Squadrons are used for this work. Flying to the reported scene of a "ditching," often 200 or more miles from base, they search for survivors, drop containers of food, etc., bring surface craft to the rescue or drop air-borne lifeboats and guide the rescued aircrews home.

These are the tasks of Coastal Command.

The Consolidated Model 39.



D. J. TURNER on Photographic RECONNAISSANCE

HAVING viewed photographic maps of large areas published in various sections of the press you may have wondered how such photographs are planned and taken. In other words, how does the photographer know how much ground is included in one picture, and when he will need to take another one.

Suppose a pilot and his camera operator are shown a map on which an area enclosing 12×8 miles is marked out, and they are told that a photographic mosaic is required of that area of ground. They would then have to set about working out a number of factors which it is necessary to know before embarking on the reconnaissance flight.

All photographic calculations are based on two triangles, placed apex to apex, their bases parallel, as shown in diagram 1. The smaller triangle represents the angle of view of the lens inside the camera, and the larger one the angle of view from the lens to the ground. The vertical line joining the bases and apexes of the two triangles represents the axis of the lens, which, as we are considering only vertical photographs, is perpendicular to the ground. It will be readily seen that these two triangles are similar, for the parallel straight lines forming their bases are cut by two transverse lines, forming equal and opposite angles.

Therefore any two characteristics o one triangle will be in direct ratio to the same characteristics of the opposite triangle. For instance, if the relationship between A and B in diagram 1 is 3 to 4, then this would also apply to C : D. Thus we can say that $\frac{A}{B} = \frac{D}{C}$ or $\frac{A}{D} = \frac{B}{C}$ and this latter is the formula we shall use as a basis for all our calculations. Now let us find what the symbols represent.

A = Width of picture in inches.

B = Distance of the camera lens from the film in inches.

C = Vertical height of the aircraft in feet.

D = Length of ground covered by one picture in feet.

E = The lens of the camera, and is not used in these formulæ. Its inclusion in the diagram is for purely illustrative purposes.

Of the above factors A and B are always known, and for the purpose of these calculations let it be assumed that the camera takes a picture 6 inchcs square, and that the distance from the lens to the film is 10 inches. Height i of course, a factor which can be decide before taking off, and we will assume to be 15,000 feet. So three factors ar available, A, B and C, and the only unknown factor is D, the length of ground covered by one picture.

Reverting to the parent formula $\frac{A}{D} = \frac{B}{C}$ you will see that here we have a four-figure equation, and if three factors are known the fourth can always be found. Thus $A = \frac{D \times B}{C}$: $B = \frac{A \times C}{D}$: $C = \frac{D \times B}{A}$ and finally, the factor which we want to know, $D = \frac{A \times C}{B}$. Replacing the symbols with figures this gives us $\frac{6 \times 15{,}000}{10}$, which equals 9,000 feet. This means that one photograph is covering an area on the ground 9,000 feet square. It will be readily seen that the area required to be photographed, namely 12×8 miles, cannot be included in one picture. It will, in fact, be covered by a mosaic of pictures as shown in diagram 2.

In order to photograph this area it is necessary to make a number of runs along its length, taking photographs at fixed intervals. Thus if each successive photograph included 9,000 feet of ground, we ought to be able to bring 12 miles to feet and divide by 9,000, which would give us the number of pictures to take in one run.

However, this cannot be done, because there is another factor to be considered, namely overlap. Many of you will have seen photographs at various R.A.F. exhibitions which are termed stereoscopic, because when viewed through suitable lenses they give the photograph an illusion of the third dimension. That is to say, instead of the subject appearing flat, as in an ordinary photograph, it seems to have depth, breadth and height. Buildings and hills in an aerial photograph appear to rise up from the ground. This stereoscopic vision is of great value to the experts assessing bomb damage from the photos, and it is also an aid to detecting camouflage. To obtain this perspective it is necessary for two photographs to be taken from slightly different viewpoints approximating to the distance between our eyes. This is shown in diagram 3, in which it will be seen that successive photographs are made to overlap the preceding one by 60 per cent, thus giving the required stereoscopic vision.

It will thus be seen that the fresh ground covered by successive pictures is not the whole length of D, but only 40 per cent of it. So to find how many pictures would be needed to cover one run, divide the length of the run by 40 per cent of D.

D is known to be 9,000 feet, so 40 per cent of it equals $\frac{9{,}000 \times 40}{100}$, which cancels out to 3,600 feet, so this figure is divided into the length of the area, which is 12 miles.

Thus $\frac{12 \times 5280}{3{,}600} = 17$ and 3/5ths, which is the number of exposures required to photograph the length of one run, each photograph overlapping its predecessor by 60 per cent. However, it is obviously impossible to take 3/5ths of a picture, so another complete photo would have to be taken, making a total of 18 pictures per run.

Having found this, it is now necessary to find at what time interval successive pictures are to be taken to obtain the required 60 per cent overlap in a forward direction.

Referring to diagram 3, it will be seen that the sides of triangles (1) and (2) form a parallelogram, and what has to be found is the time taken to fly 40 per cent of D, which is the distance between successive pictures being taken to preserve a forward overlap of 60 per cent. So the time lapse between successive pictures would be

$$\frac{\text{40 per cent of D}}{\text{Speed of aircraft in feet per second}}$$

40 per cent of D has already been found to be 3,600 feet, and a ground speed of 200 m.p.h. will be assumed. To convert M.P.H. to feet per second and be strictly accurate a factor of $\frac{22}{15}$ should be used, but for the purpose of these calculations it is quite sufficiently accurate to multiply by $\frac{3}{2}$, which gives only a small error. Thus $200 \times \frac{3}{2}$ equals 300 feet per second. Therefore the time interval equals $\frac{3600}{300}$, which cancels out to 12 seconds.

What must be found now is the number of successive runs needed to photograph the whole area. Whilst the overlap is kept at 60 per cent in a forward direction, each successive run is required to overlap its predecessor by only 30 per cent, which is purely to ensure the runs preserve continuity of ground, and that none shall go un-photographed. This is illustrated in figure 4. It will be seen that the fresh ground covered by each run divided into the width of the area will give the required number of runs to photograph the area. The formula is thus $\frac{\text{Width of area.}}{\text{70 per cent of D}}$ First find 70 per cent of D, which equals 6,300 feet. Thus the number of runs $= \frac{8 \times 5280}{6300}$, which cancels to $6\frac{74}{105}$.

As with successive pictures per run, we cannot take a fraction of a complete run, so to cover the area 7 runs would have to be made.

Thus the complete answer to the problem is as follows:

Number of pictures per run = 18.

Time interval between pictures to give the required 60 per cent overlap = 12 seconds.

Number of runs = 7.

Finally, should it be necessary to know the scale of the photographs, this can easily be found by $\frac{\text{A in inches}}{\text{D in inches}}$ or $\frac{\text{B in inches}}{\text{C in inches}}$, both of which will give the same answer. Using the first formula scale, expressed as a representative fraction, would be $\frac{6}{9000 \times 12}$ which equals 1/18,000, meaning that one inch on the photo equals 18,000 inches on the ground.

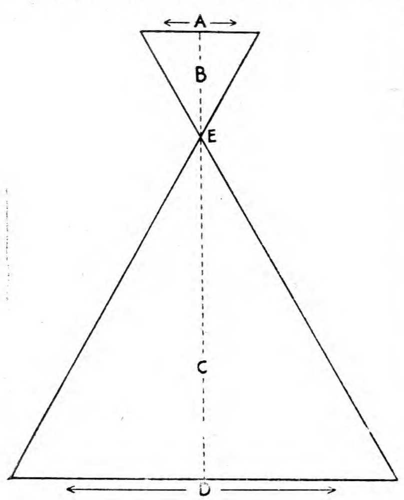
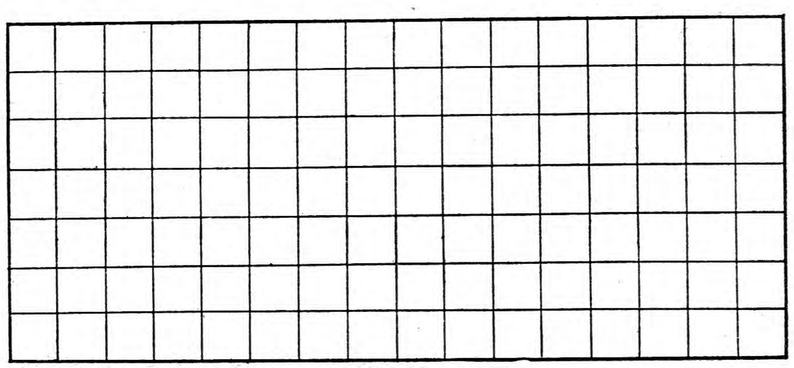


DIAGRAM Nº 1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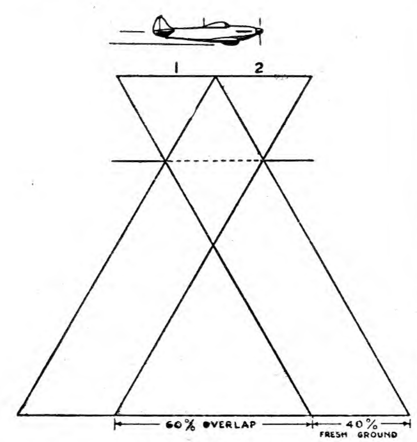


DIAGRAM Nº 3

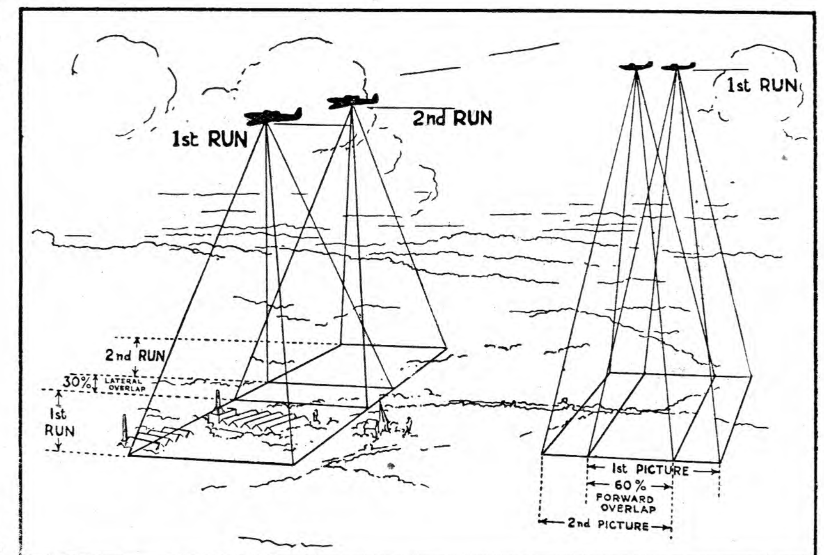
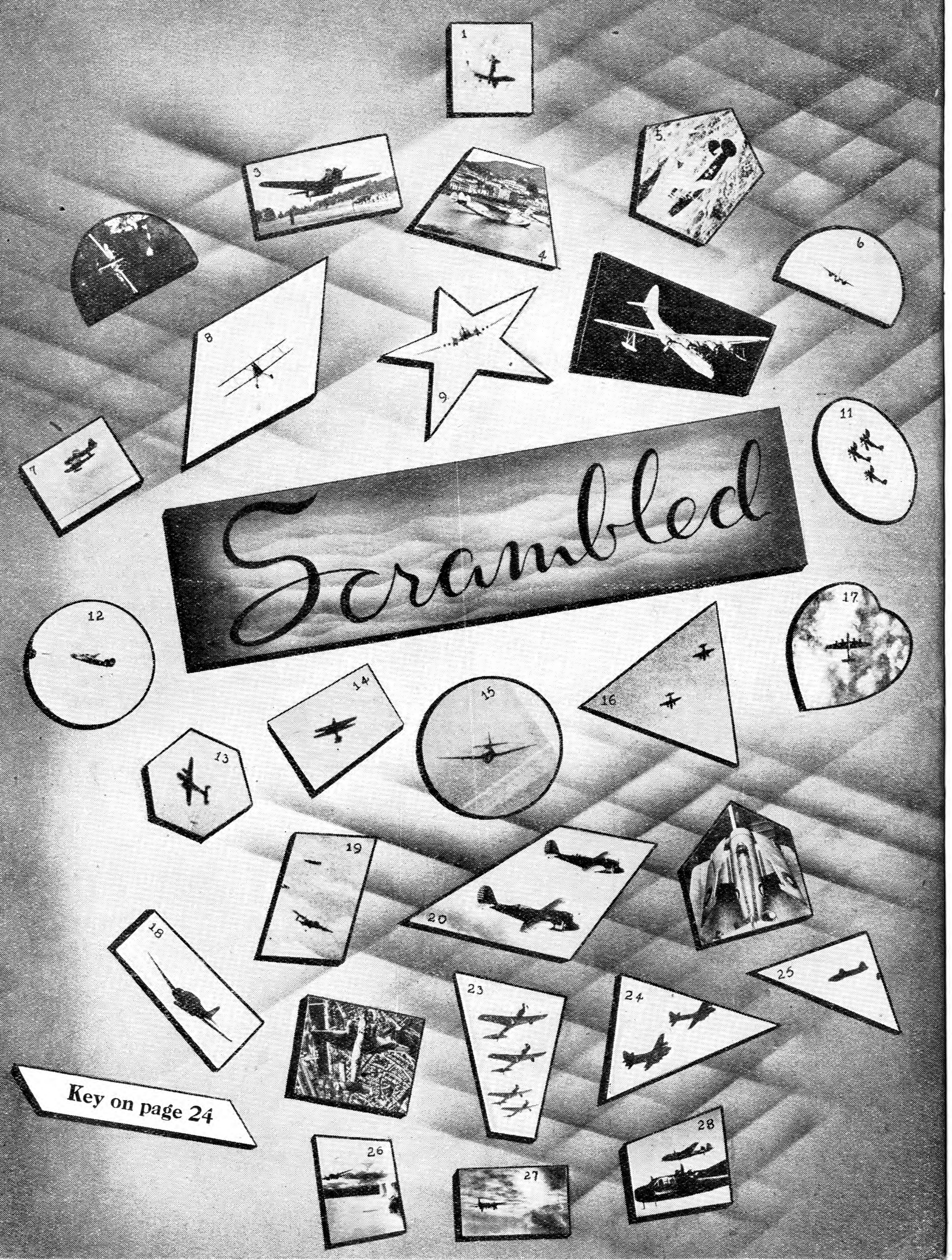


DIAGRAM Nº 4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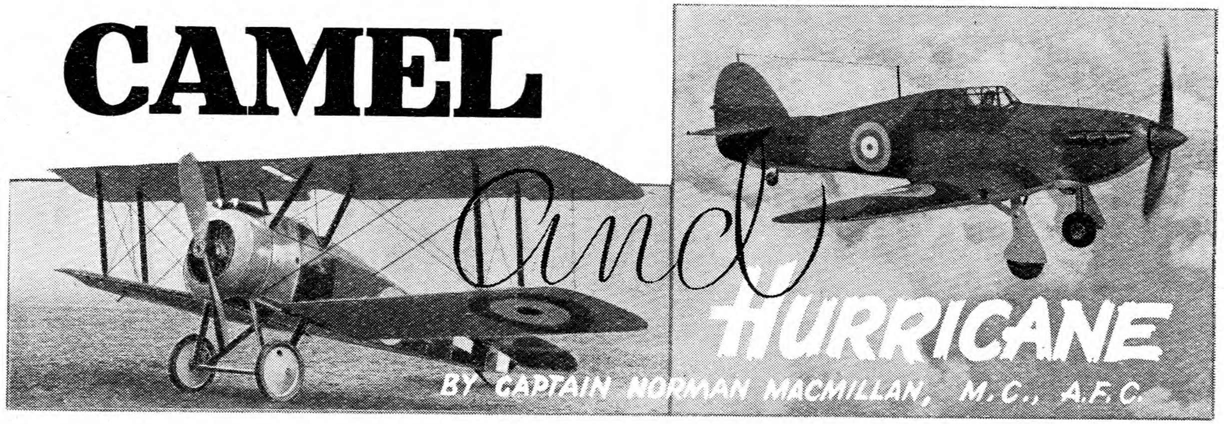
Key on page 24

CAMEL and HURRICANE



FIFTEEN Camel squadrons flew with the R.F.C. branch of the R.A.F., including one Australian squadron. They served in France, Italy, Salonika and on Home Defence. Seven R.N.A.S.-R.A.F. Camel squadrons served in France, with three more in the Mediterranean. Of 99 squadrons in France at the 1918 Armistice, 17 had Camels.

Ten Hurricane squadrons were based in France during the Battle of France, and two more were re-equipping from Gladiators to Hurricanes. At least 30 Hurricane squadrons were in the United Kingdom during and just after the Battle of Britain. Hurricanes have fought over Europe, in Russia, North Africa, India, the Far East and at sea. They defended both London and Calcutta.

We do not yet know the total bag of the Hurricane and the Sea Hurricane, but there is no doubt that this World War fighter is a redoubtable successor to the Camel of the Great War.

R.F.C. Camels destroyed 908 enemy aircraft, R.N.A.S. Camels a further 373, a grand total of 1,281, with many observation balloons in addition.

Fighter-Bombers

But do not imagine that the Hurricane was the first fighter-bomber. The Camel was. On August 13th, 1918, 40 Camels attacked Vassennaere aerodrome in Belgium, dropped 142 25-lb. bombs from between 200 and 500 feet, and set six out of nine Fokkers alight. A petrol dump went up in flames, workshops and hangars caught fire. The place was then shot up with machine-guns. Not one Camel was lost, for the Germans were taken completely by surprise.

At Sea

Two Camel incidents at sea are history. A detachment of the Grand Fleet, including H.M.S. *Furious,* reached a point 80 miles from Tondern airship base early on July 19th, 1918. Seven Camels started from the *Furious.* The first flight of three Camels set one of the two Zeppelin sheds on fire and gutted it; two Camels were lost. One naval Camel flew off a lighter towed behind a destroyer in the Heligoland Bight, climbed to 19,000 feet, and shot down a Zeppelin, single-handed, in broad daylight on August 11th, 1918.

Hurricanes were the first eight- and twelve-machine-gun fighters, the first four-cannon-gun and tank-buster fighters, and the first single-seater monoplane ship fighters made in Britain.

The different points of the Camel and Hurricane give us a good idea of the advance made in fighter aircraft in 20 years—from 1917 to 1937. In each case we will take the standard 130-h.p. Clergêt Camel and the 1,030-h.p. Merlin Hurricane I.

The Camel's span of 28 ft. increased to the Hurricane's 40 ft.; length 18¾ ft. became 32¼ ft.; all-up weight from 1,450 lb. to 6,666 lb.; wing area 231 sq. ft. to 257½ sq. ft. (not such a great difference here); track 4 ft. 8 in. to 7 ft. 10 in.; height 8½ ft. to 13 ft. 1½ in.

Armament

The Sopwith Camel had two Vickers machine-guns firing through the airscrew disc, with a Kauper mechanical or Constantinesco hydraulic interrupter gear to screen the two-bladed fixed wooden airscrew from damage by bullets. Uninterrupted rate of fire was approximately 600 rounds per minute per gun, with an actual total rate by both guns after interruption of about 900 rounds per minute. Ammunition carried was about 900 rounds of .303-in. calibre, which was usually fired in bursts of from 50 to 250 rounds. Each gun could be fired separately by pressing a left or right square-shaped thumb trigger mounted within the circular handgrip of the stick; both guns were fired simultaneously by pressing both triggers at once. The guns were mounted on the top deck of the fuselage. In a crash the pilot's face often got dented by the gunbutts. Sights were a ring and bead and an Aldis tube sight. There were no adjustments for rudder-bar or seat; no trim tabs or other adjustments for air controls. The machine usually flew tail-heavy. Service ceiling was 19,000 ft. Maximum speed at a thousand feet was around 120 m.p.h. The fixed undercarriage had no wheel brakes and was sprung with rubber elastic. That was the Camel.

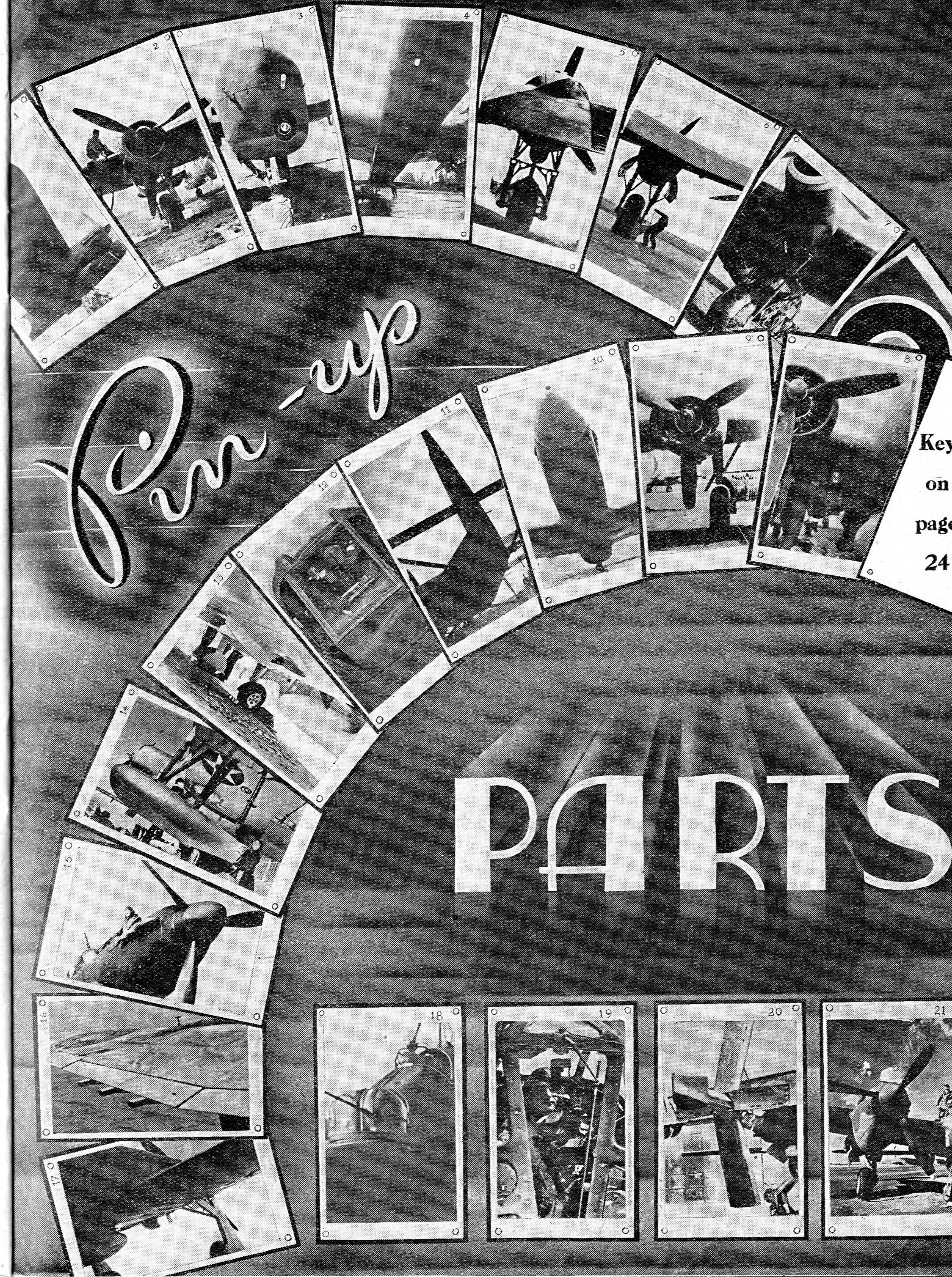
The Hawker Hurricane I monoplane had eight .303-in. Browning machine-guns mounted, four in each wing, and firing outside the wooden fixed, V.P. or C.S. metal airscrew's disc. All guns were fired simultaneously by compressed-air control from one small firing-button mounted on a circular handgrip of strikingly similar pattern to that of the Camel. The total rate of fire was 9,600 r.p.m., more than ten times greater than the Camel's. Bursts averaged from about 500 to 800 rounds. Each gun had 300 rounds, a total of 2,400. Guns were sighted by a reflector sight which, when switched on, outlined the deflector ring on the windscreen. There were adjustments for rudder control and seat, and trim tabs for the air-control surfaces. Service ceiling was 36,000 feet. Maximum speed 330 m.p.h. The retractable oleo undercarriage was fitted with wheel brakes. That was the Hurricane.

Camel pilots, when offered electrically heated clothing, rejected it, because it meant carrying a dynamo, wind-driven, on one wing where weight and drag would decrease performance. They preferred to freeze in their open cockpits in winter rather than lose performance.

Hurricane pilots flew in closed cockpits, using electrically heated clothing when required, and oxygen. Unlike their Hurricane successors Camel pilots had no oxygen, no parachute and no dinghy.

Communication

Camel pilots had no means of communication with the ground except by firing Very lights, or making the aircraft perform some distinctive evolution according to a code. Pilots flying in close formation signalled to one another by hand signals, and at greater distances by firing Very lights or rocking the wings from side to side. They became so accustomed to each other's flying that formations could fly instinctively almost as one machine.



Key on page 24

The Sabre Engine

By **J. A. Kyd**

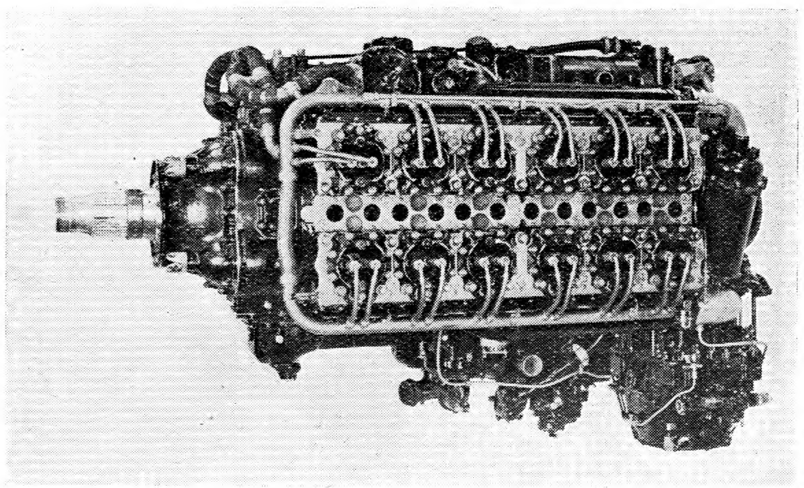
Hardly bigger than a lorry engine, yet it develops 2,200 h.p.

"COMPACT power" is a fairly common term used in conjunction with the modern aero-engine, but in no case can it be applied with greater truth than to the Napier Sabre. This aero-engine, with its 24 cylinders in four banks of six arranged in horizontal H fashion, is rectangular in shape, with no apparent gaps. Stripped of its accessories, it would look hardly bigger than a heavy-lorry engine, yet is develops as much as 2.200 h.p.

When it is installed in the Typhoon and Tempest one is apt to overlook the neatness of the cowling round the Sabre. But take a photograph of either as is the case in a more conventional type of aero-engine. Furthermore, the two banks of horizontally opposed cylinders each has a separate crankshaft, and these are geared together at the front of the engine to drive the propeller shaft; the result is that the impulses balance themselves out.

Coolant System

Multiplicity of cylinders calls for careful design to maintain even and proper working temperatures, and to avoid complex mechanism for valve gear, etc., which would not only increase the size of the engine, but would



aircraft, and cover the bulky combined radiator, oil cooler and air intake, and the achievement of packing 2,200 h.p. into a small single-engined fighter without upsetting its "lines" to any degree is at once obvious.

Flight behind a Sabre is said to give one a greater sense of power than in any other aircraft, and yet it is a beautifully docile engine to handle. The melodious drone of the engine in flight is unique, and gives the impression of effortless and smooth power output.

High r.p.m.

Features of particular note about the Sabre are the fact that it has got 24 cylinders and its high maximum r.p.m. of 3,700. This high engine speed and the smoothness of running are directly due to the abnormally high number of cylinders for the engine's capacity, which means that the power is derived from a lot of small impulses rather than from a few big impulses, complicate maintenance. The Sabre's coolant system consists of two centrifugal pumps which circulate coolant consisting of 70 per cent water and 30 per cent ethylene-glycol (normal aero-engine coolant) at a pressure of 30 lb. per square inch. The circulation is through the cylinder heads and around the cylinders, after which the coolant is led back to the pumps by way of a spiral duct, which gets rid of any steam through escape holes cut in the *inside* of the spiral. The coolant circulating through the spiral is centrifuged to the outside of the pipe, leaving any steam to escape through the holes in the inside. The steam condenses in the header tank, into which it escapes, or, if it builds up too much pressure, it operates a relief valve. The coolant flows back to the pumps either directly or by way of the radiator. This will depend upon the thermostatic valve, which, until the engine reaches its normal operating temperature, directs the coolant straight back to the pump instead of through the radiator. During normal operation of the engine, coolant may be flowing back to the pumps, both through the by-pass and through the radiator.

Sleeve Valves

Compactness, ease of maintenance and silence of running are all enhanced through the use of sleeve valves. The two rows of cylinders at each side of the engine each have their sleeves driven from a common shaft.

The Sabre has a two-speed supercharger to maintain its performance at altitude, and its output of 2,200 h.p. for a weight of 2,360 lb gives the remarkable power-to-weight ratio of 1.07 lb. per h.p. This ratio may not be as high as some aero-engines in service with the R.A.F. today, but the Sabre is still in its infancy as far as development is concerned, and great things may be expected of it in the future.

Pin-up Parts

(SEE PAGE 23)

1, Avro Lancaster; 2, Bristol Beaufort; 3, North American Mitchell; 4, Short Stirling; 5, Douglas C-47 Dakota; 6, Avro Lancaster; 7, Short Stirling; 8, Boeing Fortress; 9, Consolidated Liberator; 10, North American Mustang; 11, Airspeed Horsa; 12, Consolidated Liberator; 13, Supermarine Spitfire; 14, Vought-Sikorsky Kingfisher; 15, Boulton & Paul Defiant; 16, Handley Page Halifax; 17, Hawker Hurricane; 18, Bv 138b; 19, Consolidated Liberator; 20, Do 217e; 21, Lockheed Lightning.

Scrambled

(SEE PAGE 20)

1, Fw 58; 2—unnumbered (left of No. 3), Avro Lancaster; 3, North American O-47B; 4, Boeing 314A; 5, Consolidated Liberator; 6, Douglas Boston; 7, Vought-Sikorsky Kingfisher; 8, Boeing PT-17; 9, Douglas Dakota; 10—unnumbered (right of No. 9), Vought-Sikorsky XPBS-1; 11, Fairey Swordfish; 12, Consolidated Liberator; 13, Do 217; 14, D.F.S. 20; 15, Grumman Avenger; 16, Martin Marauders; 17, Handley Page Halifax III; 18, Kate (Nakajima); 19, Avro Lancasters; 20, Martin 139; 21—unnumbered (right of No. 20), Grumman Wildcat; 22, unnumbered (left of No. 23), Lockheed Vega Ventura; 23, Vultee Valiants; 24, Boeing B-17F Fortresses; 25, Betty (Mitsubishi); 26, North American Mitchell; 27, de Havilland Mosquito; 28, Nell (Mitsubishi).

Flying Commentary *by the Editor*

WE are again fortunate this month in being honoured by an article by Air Chief Marshal Sir Sholto Douglas, Air Officer Commanding-in-Chief Coastal Command, who writes of the great work done by that Command now and during the years that we were holding off the enemy and building up our strength. Coastal Command's work is largely concerned with Western waters, but much of the same sort of work must be carried out in the Pacific, and must be carried on for some time after the occupation of Berlin.

ANONYMOUS-LETTER RECORD

WHEN a major change occurs in the A.T.C. we usually get a number of anonymous letters, and we were not unprepared for an avalanche when the transfer of deferred-service men to the Army were announced. However, only one was received. The Corps has generally taken it in good spirit, and the cadets have realised that many people besides themselves have been directed to uncongenial war-work. They also realise that the R.A.F. will continue to take in some men of each age group, and that there may be chances of civil flying after the war. In one squadron, when the maths. class were assembling the remark was heard: "If we are going to be guardsmen, we might as well get our Proficiencies first."

MODEL CONTESTS

THE Association of British Aeromodellers announces some interesting contests for modellers, in which some £300 in cash prizes is offered as well as many trophies. Particulars can be obtained from the Association at 28 Hanover Street, London, W.1.

MODEL EXHIBITION

AN exhibition of models is being held at the Bristol Showrooms, Piccadilly, London (corner of Dover Street), by the National Association of Spotters' Clubs early in September. Full particulars will be found in *The Aeroplane Spotter*.

DOODLE-BUGS

DOODLE-BUGS are such a favourite topic of conversation that it is hard to keep them out of the *Gazette*. But I should like to record how well the cadets in Southern England are carrying on in spite of them. Two of the cadets on the *Gazette's* staff have had their homes destroyed, one of them being slightly injured in the process. The other made so little fuss about the flying bomb which wrecked his home while he was at work that he arrived exactly on time the next day, and did not mention it to me until I happened a day or two later to ask him whether he had lost any windows.

In one very vulnerable area in Southern England an A.T.C. gliding school carries on as usual during "alerts," stopping to take cover in slit trenches only when a spotter announces the approach of a doodle-bug unpleasantly near.

BLAST

IT is our boast that we don't let the doodle-bugs interfere with our work, so we shall blame neither them nor the members for the fact that on page 9 of the August issue the Fairey Seal in the top picture was referred to as a Swordfish, and the Albacore with its wing folded in the lower picture was slightingly called a Stringbag. These things do happen occasionally, and we offer no excuses, only the apology. Also for the fact that on page 12 the words 'clockwise' and 'counter-clockwise' became reversed, as is apparent from a careful reading of the preceding sentence.

Books

Radio Questions and Answers

Vol. 1—Basic Radio. By E. M. Squire. Pitman. 5/-. 86 pages.

Brief questions with substantial and detailed answers of elementary electricity, magnets and electromagnets, cells and batteries, inductances, transformers, condensers, meters and valves.

Teach Yourself Meteorology

By "Aeolus." Hodder & Stoughton. 3/-. 138 pages.

Interest in the weather is so universal that teaching yourself meteorology may perhaps be easier than teaching yourself more abstruse subjects. This book makes a good effort to dispense with the teacher, and the intelligent reader should be able to learn much from it.

Engineering Drawing Office Practice

British Standard 308:1943. British Standards Institution, 28 Victoria Street, London, S.W.1. 3/6 post free. 50 pages, 5 appendices and 5 plates.

Any young engineer who is thinking of becoming a draughtsman will find information giving all detains required in engineering drawing office practice, such as sizes of drawing boards, drawing paper, tracings, types of reproduction prints, those particulars which should be included on every drawing, scales recommended to be used, methods of projection, different kinds of lines and lettering, and all other required information.

An essential reference book for every draughtsman and every drawing office.

Gas Turbines and Jet Propulsion

By Geoffrey Smith, M.B.E., Managing Editor of *Flight*. Price 6/6 post free, from Flight Publishing Co. Ltd., Dorset House, S.E.1.

This is the first published book to deal with aircraft-propulsion plants employing gas turbines and rotary air compressors, and it is only in this third edition that Group Captain Frank Whittle receives the recognition due to him for being the successful pioneer in the development of the small gas turbine.

Now that the gas turbine and the jet propulsion of aircraft are accomplished facts, there will be many eager young engineers and designers anxious to devote themselves to the new technique, and in this book they will find some of the details of the knowledge which Whittle used to reach his success.

Because the wording is largely non-technical the book will interest everyone, and an added attraction is a brief description of the careers of Frank Whittle, W. G. Carter, who designed the Gloster jet-plane, and P. E. G. Sayer, who piloted it.

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