AIR TRAINING CORPS GAZETTE

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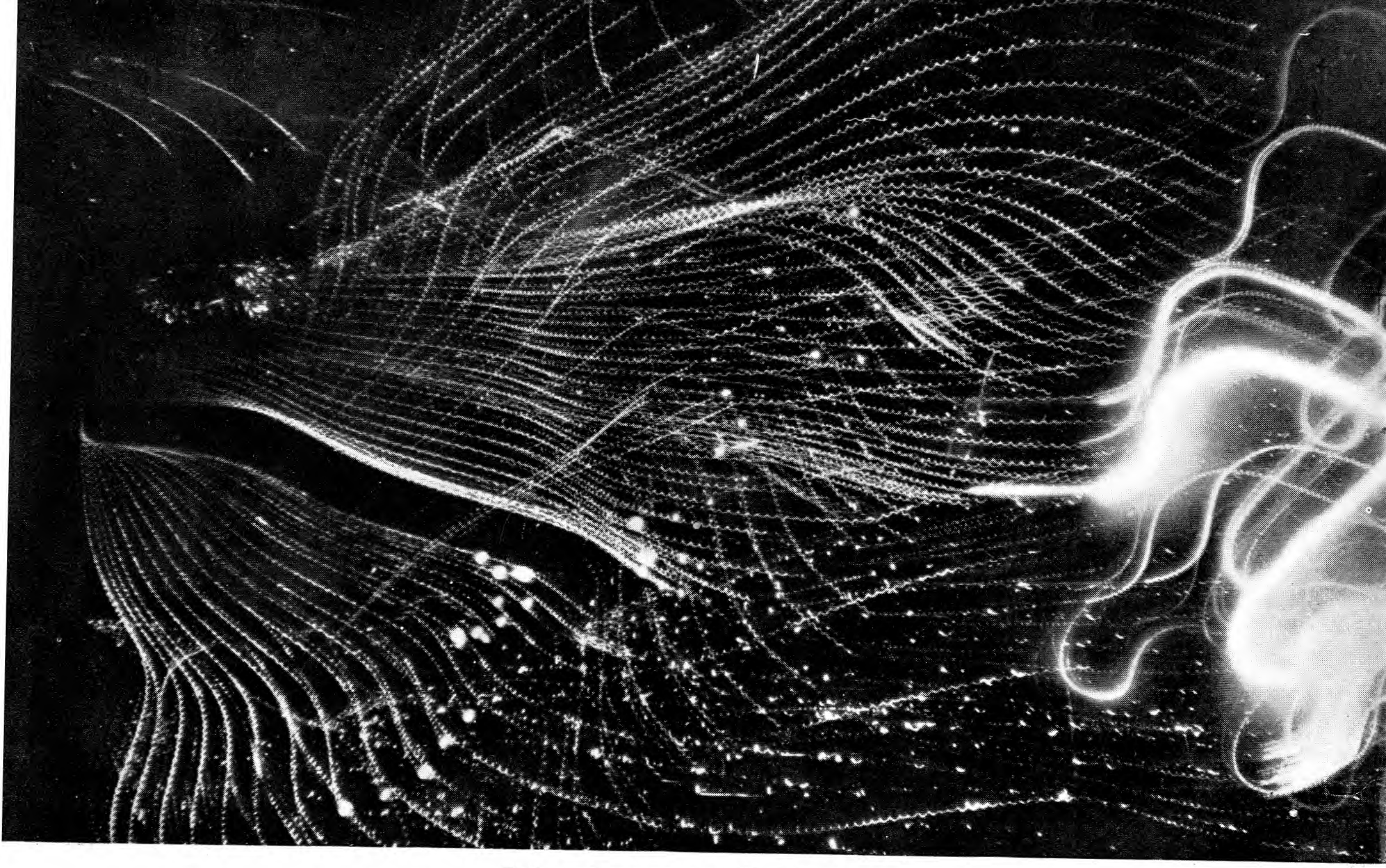
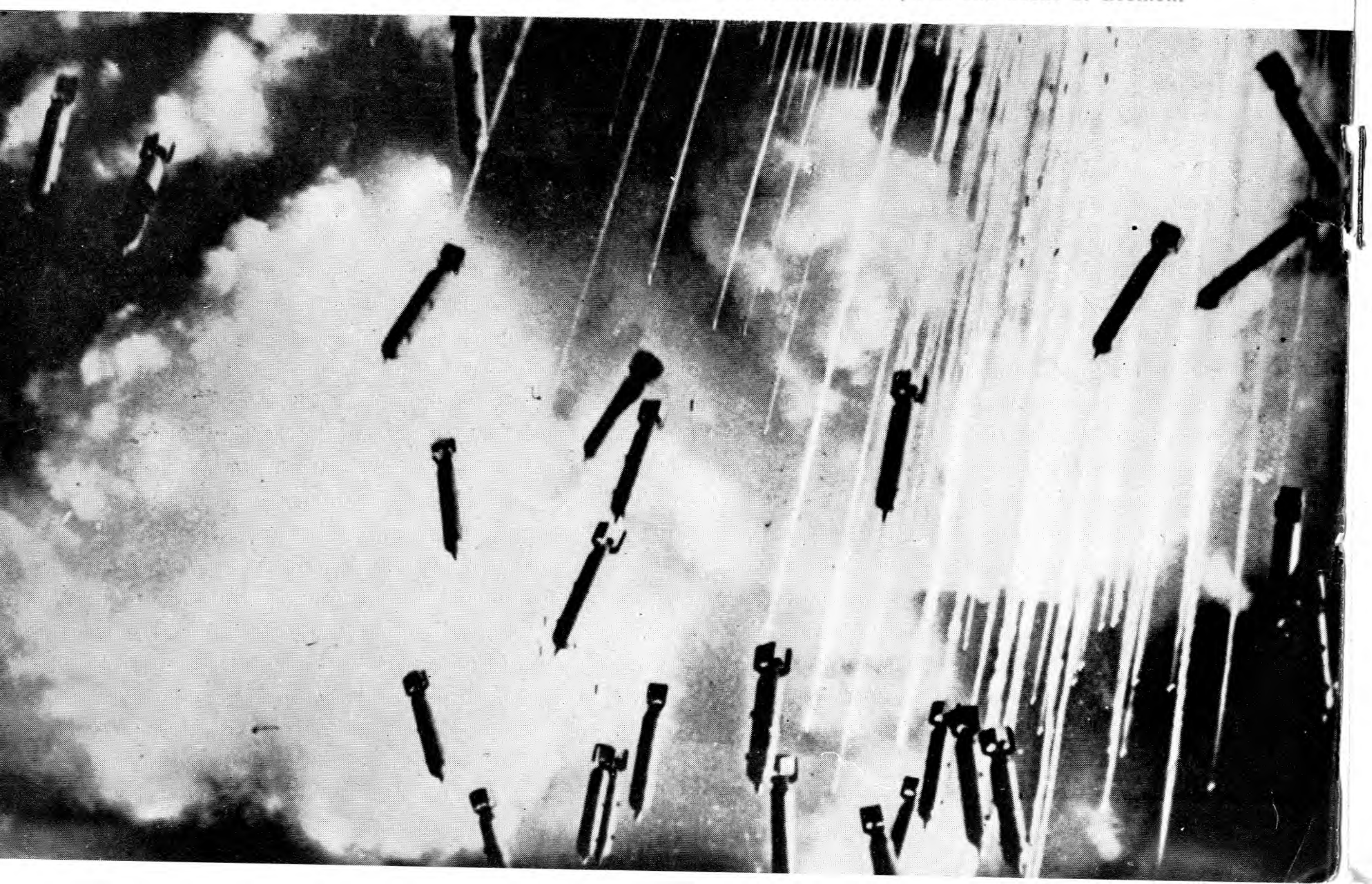


Flak and tracer over Hamburg.

Bombs from Liberators and Fortresses on their way down to the submarine yards and docks at Bremen.



AIR TRAINING CORPS GAZETTE

VOL. IV NO. 2 FEBRUARY 1944

Edited by Leonard Taylor

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The Chief Commandant's message:

All will be well, if . . .

GENERAL MONTGOMERY, before leaving the Eighth Army in Italy, made the remark that the end of the war was in sight. General Montgomery is not wrong in statements like this, but he added that the end can only be achieved, or even brought nearer, by at least the maintenance—and better still, by an intensification—of our present effort. Victory is now in our grasp, but we cannot afford to let up for an instant, or it will pass us by, possibly for a long time—at the worst, for ever. Success depends on each one of us.

We have got to defeat Germany first. When Germany is defeated, a major war with Japan will still be on our hands. The defeat of Germany is not the end; the job will not have been thoroughly done until the Japanese war-lords have been utterly destroyed too. And after that a lot of policing and keeping the defeated enemy in order will remain to be done for a very long period to ensure that, unlike after World War I, the forces of evil, having once been beaten down, are not allowed to resurrect themselves, *ever*.

What we have to do in the A.T.C. now, whilst this war lasts, is to fit ourselves to provide the best possible material upon which the Royal Air Force and Fleet Air Arm can draw for its aircrews and, where applicable, for ground personnel. This is the mission of the A.T.C. now, and it is of vital importance to do all we can to further it. The more trained each cadet is the greater the asset he will be when he joins the R.A.F. and F.A.A.

Just for a moment think of the mighty effort of Bomber Command, which grows in strength against Germany from day to day and night to night, of our fighter successes over France and Italy, and of the rough handling of the U-boats, in which the Coastal Command and the Fleet Air Arm, in co-operation with the Royal Navy, are playing such a decisive part. All these tasks require more and more effort behind them; and upon you who are preparing yourselves depends the acceleration with which our blows can be redoubled. There is plenty of work for each of you to do now, and there will be plenty more for many years to come. When the enemy has been beaten down, the straightening out of things will take a very long time, and there is little doubt that the Royal Air Force will play a great part in this. It is playing a glorious part now, and that will not be allowed to lapse. Therefore you will be needed nearly as much in the future as you are now, in war; and remember, "to falter now will be to fail"; and we must not fail, but pay our due to posterity by ensuring that we of these times do not let posterity down by being unprepared as we were before this war. The responsibility is a heavy one, and we must not shirk it.

I have been the fortunate person selected to lead you through the difficult times that lie ahead, as long as the war lasts, and into the time that follows it, and I am fully aware of the issues involved. I gladly take up the task, as I know how vital for us it is to be successful.

From the contacts I have already made with the Corps I know the fine material that is at my disposal, the wonderful results already achieved and the keenness of all officers and cadets to strive for yet better things. I am, therefore, making it my duty as soon as I can to get to know everything about the A.T.C., about yourselves, your training, where you work, and your general conditions. This I hope to achieve by means of visits, the object of which will be to make us mutually acquainted.

Thanks to your enthusiasm, the Corps has gone ahead by leaps and bounds, and it is now so vast that I cannot hope, even in a year, to visit every unit. This is my misfortune, but I trust my visits, where they are made, will range very wide, between the Shetlands and the Scillies, and to Northern Ireland, over which great extent the Corps now stretches.

I feel I have no need to ask for your support; I am sure it will be given in full measure, as it has been to my predecessors who have led the A.T.C. so well before me. The R.A.F. still wants as many aircrews as we can give them. Keep your keenness going now and in the difficult years that lie ahead. There is plenty of hard work to be done. Work hard yourselves and persuade those who are coming in after you to do the same, and all will be well with the A.T.C., the Royal Air Force and the Fleet Air Arm.

E. L. GOSSAGE (Air Marshal),
Chief Commandant and Director-General of the Air Training Corps.

GOOD-BYE AND GOOD LUCK

FOR two years I have had the great privilege of directing the activities of the Air Training Corps.

During this period the Corps has passed into the Services directly from its ranks cadets in numbers fast approaching 100,000. All those officers, instructors and members of committees who have done so much for the training and welfare of their cadets have the satisfaction of knowing that the Corps as a reservoir for the Royal Air Force and Fleet Air Arm has more than fulfilled the highest expectations.

But the job is not yet finished. Our enemies, Germany and Japan, have still to be beaten, and until this has been achieved I know that the Corps will give to Air Marshal Sir Leslie Gossage that same enthusiastic support which has been given to me and for which I cannot give adequate thanks.

But, when the war is won, great though the work of the Corps has been in the hour of the country's greatest need, an even greater task lies ahead in the years of peace.

If this country is to play its proper part in future world affairs then its young men must be air-trained and air-minded. I know of no better medium for this purpose than the Air Training Corps.

I believe that the future destiny of our country depends on the extent of its air-mindedness. If that is great, our country will continue to be great in spirit and in achievement.

The foundations for air-mindedness will rest with the cadets and their leaders of the Air Training Corps. To the extent that those foundations are firm and solid, so will our future security depend.

Good-bye and good luck.

W. W. WAKEFIELD.

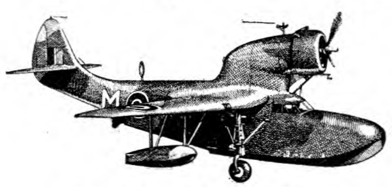
Amphibians

by A. M. Colbridge

POSSIBLY the first conception of the amphibian belongs to Alder, a Frenchman, who outlined such a machine in 1898, before even the Wright brothers had flown. Records show that the first man to rise off water and land on solid earth did so on March 28th, 1910. His name was Henri Faber, and the flight took place from the Gulf of Fos at Martignes. The machine was a normal landplane of the time fitted with a system of hydrofoil floats.

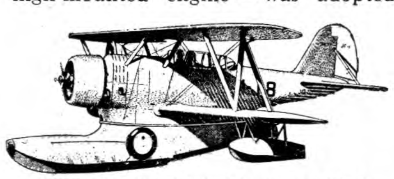
Flying Duck

In 1922 the United States Navy started experiments on a Loening monoplane seaplane. The Loening



A modern "Flying Duck," the Fairchild 91.

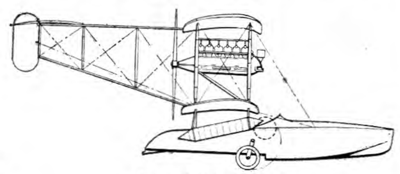
amphibian had a flying-boat hull which resembled a boot in shape, biplane wings and an inverted Liberty engine mounted in the centre between the wings. Top speed was 124 m.p.h. and service ceiling 15,000 feet. The land undercarriage retracted into wells in the side of the hull. Wing-tip floats were fitted for water stability. This design layout — single central hull carrying the retractable landing-gear, outrigged floats for water stability and high-mounted engine — was adopted



A "Flying Boot," the Grumman JF-1.

more or less as standard. It has earned the nickname of the "flying duck."

Some interesting aerodynamic points arose out of this design which showed that amphibian (or any marine) aircraft design introduced specialised problems. The centre of gravity was low, and it was thought that this would tend to make the machine overbank. To overcome this all the weights were concentrated as far as possible around the centre of gravity and weathercock stability reduced to a minimum.

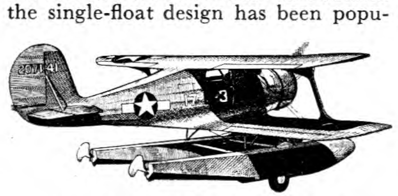


Sopwith Bat boat.

Sikorsky Success

A return to the Bat-boat layout in 1925 with the first of Igor Sikorsky's long line of highly successful amphibians. The S-36 was the first boat with a short cabin hull (very much like the shape of a cabin-cruiser motor-boat), with wings and tail unit carried on a multitude of struts. The undercarriage tucked up against the sides of the hull.

Several other types also appeared in the late nineteen-twenties. In America the single-float design has been popu-



Beechcraft twin-float amphibian.

lar, and it was comparatively easy to arrange to fit a land undercarriage to this which could be retracted when not required.

In this country we have favoured the twin-float seaplane, some of which were converted into amphibians by fitting wheels into wells in the underbody of each float (as in the early Caudron), such wheels partly protruding the whole time, or even made to retract within the float. Water resistance and air drag were both high, which seriously impaired efficiency. Possibly the most popular type was, and still is, the small flying-boat to the hull of which is attached the landing-gear. This retracts into the fuselage or wings.

Utility Shagbat

The highly successful Supermarine Seagull, designed in 1923 and direct descendant of the Supermarine Baby of 1920, has developed into the Walrus or "Shagbat," one of the most useful and popular of utility types still giving excellent service today.

Summarising, we may say that the main types of amphibians are as follow:

Flying-Boat Amphibians

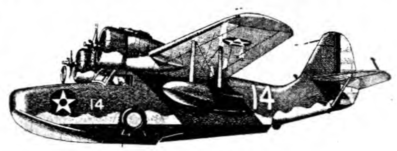
(1) Normal flying-boat design with amphibian gear capable of being drawn up or completely retracted when not required. A combined water rudder and tailskid, serving the same useful purpose on land and water, is generally fitted to the rear of the hull.

(2) The Bat-boat type, with motorboat hull suspended below or faired into the wings and tail carried on outriggers. Engines are mounted in the wings. Retractable gear as above.

(3) The "flying duck"—really a variation of (1), with nacelles faired into the general lines of the fuselage.

Floatplane Amphibians

(1) Single float. (*a*) Single-float seaplane with small outrigged auxiliary



The Grumman OA-9 Goose.

floats. Amphibian gear attached to main float, and is retractable or semi-retractable. (*b*) The "flying boot," in which the fuselage and main float are "blended" together, approaching flying-boat design. Retractable gear as before.

(2) Twin-float — normal twin-float seaplane with wheels carried in recesses in the float bottoms. This system suffers from many inherent disadvantages.

In all cases there are again variations of the groups given above, and special structural problems must be borne in mind. Part, at least, of the float or hull will be called upon to perform the duty of a tailskid, or support the water-rudder/tailskid during ground landings, and must be strong enough to stand wear.

The modern tendency is towards the monoplane flying-boat amphibian, which, together with a tricycle retractable land undercarriage, is approaching the ideal solution.

Technical Reconnaissance

by **AERO-SPEE**

OIL DILUTION

AERO-ENGINES suffer from oil-drag just as much as any other form of petrol engine. Seldom in war-time are aircraft kept in hangars, and oil which has been standing in an air-craft all through a freezing night acts as quite an impediment when the starter tries to turn the engine.

Oil dilution is now in use on many operational aircraft, and the result is to enable a pilot to take off on an interception with a more or less cold engine.

The basic principle of oil dilution is the lowering of the viscosity of the engine oil for a sufficient time to allow the engine to start easily and reach its normal operating temperature in the shortest possible time. This is done by pumping a certain amount of petrol into the oil, which at once lowers its viscosity and allows it to circulate as freely as hot oil in the engine. As soon as the engine warms up, the petrol vapourises and leaves the oil tank through a vent pipe.

The oil is usually diluted while the engine is running and just prior to shutting down for the night. The simple action of pressing a switch in the cockpit for a few minutes is all that is required.

Oil filters have to be cleaned more often than usual when oil dilution is used, for the petrol has a cleansing action on the inside of the engine, and helps to get rid of carbon and oil sludge which, of course, accumulates in the oil filters.

FIREPROOF PETROL

RUMOURS have been circulating recently about various countries experimenting with petrol tanks to get them fireproof. The Finns have now announced how this is done by the Russians.

The inflammable part of petrol is the vapour rising off it, and the Russians have adopted the simple scheme of replacing the air in the petrol tank by an inert gas, with the result that vapour escaping from a damaged tank is non-inflammable and the fire risk is reduced to a very great extent.

They have made use of the exhaust gas, and so, apart from coolers, filters valves and a certain amount of pipe-work, the additional installation required is very small.

AUXILIARY POWER PLANTS

THE shape of things to come is indicated by the announcement, by Rotol Ltd., of their auxiliary generating plant for aircraft. It contains a small petrol engine which is coupled to a generator, and the idea is that it should work all the electrical services in an aircraft. At the present time it is difficult to imagine in what aircraft it could be installed, but it is unlikely that the firm would have gone to the expense of developing and building such a unit unless they were fairly hopeful of a market for it.

The engine itself is full of interest, and is designed by Mr. Pobjoy, famous in pre-war years for his efficient little high-revving radial engines. It is a six-cylinder horizontally opposed engine with sleeve valves, and is also a high-revver. It cools itself by driving a fan, and to all appearances would be eminently suitable for the post-war light aircraft with the addition of a reduction gear and, of course, without its generator.

CABIN PRESSURISATON

HIGH-ALTITUDE flying has become a necessity in war-time for tactical purposes and developments in aircraft and aero-engine construction have been forced forward to keep pace with this ever-increasing operational requirement for greater "ceilings."

Naturally the pilot is also affected by the rarified air, and oxygen may have to be used before the aircraft has climbed half-way to its operational height.

Flying an aircraft at 35,000 feet can be a fairly uncomfortable task, and the wearing of an oxygen mask for perhaps an hour or so does not help to make things any more pleasant, especially as the lack of pressure surrounding his body interferes with the blood's capacity for absorbing the oxygen. To make the high-altitude pilot's task a little more comfortable some single-seater fighters have now got pressurised cabins.

The idea is to put the pilot in a sealed cabin in which the air is kept up to a pressure a pound or two per square inch higher than the surrounding atmosphere. He naturally still has to wear an oxygen mask, but he is better able to absorb the oxygen, since the pressure in the cabin is equivalent to that several thousand feet lower.

The supercharging effect in the cabin is provided by an air pump of some type attached to and driven by the engine. The pump takes its air from the atmosphere and boosts it up. It is then led into the cabin through a pipe, the airflow from which the pilot can control, using the readings on a pressure gauge as a guide.

NIGHT PHOTOGRAPHY

BEFORE the war camera-film manufacturers were endeavouring to develop an ultra-sensitive film which could, in conjunction with a suitable camera, take photographs in the dark. War conditions demanded some means of taking photographs of the results of bombing at the time of the raid, and since the R.A.F. bomb, as often as not, at night, some form of night photography was essential.

The ultra-sensitive film was not a practical proposition, so the following system for night photography was adopted by the R.A.F.

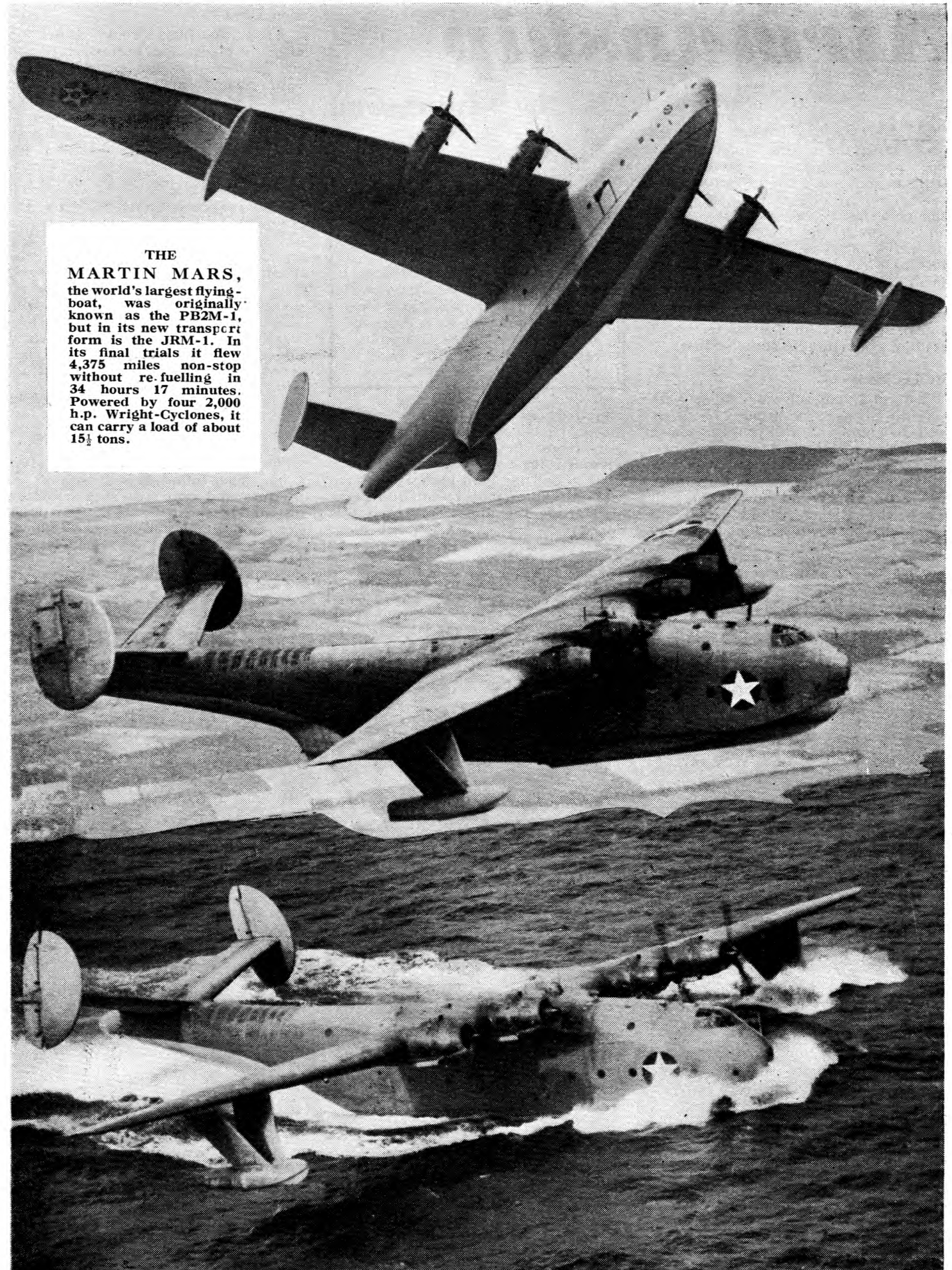
A camera is mounted in the aircraft, pointing down towards the ground through an aperture in the fuselage. When the bombs have been dropped and a photograph of the results is required, the pilot releases a very powerful flash bomb which is timed to burst before it reaches the ground. The shutter of the camera is opened before the flash is timed to burst, so that when the target area is illuminated by the flash the picture is taken. The shutter is closed automatically immediately the flash bomb bursts by the action of the intense light on a photo-electric cell. The flash is timed to occur outside the area covered by the camera, so that no direct light strikes the lens. Streaks of light often occur on the night photograph, and these are caused by tracer flak which has passed over the area covered by the camera after the shutter has been opened, but before the flash explodes.

AUTOMATIC ENGINE SYNCHRONISATION

THE Propeller Division of the Curtiss Wright Corporation, U.S.A., have announced a refinement in propeller control systems which considerably simplifies the pilot's job in multi-engined aircraft.

The Curtiss Automatic Engine-Speed Synchroniser for Multi-engined Aircraft, to give it its full name, is used to ensure that all the engines are running at exactly the same speed. Normally a pilot has to spend considerable time juggling with his propeller controls until all the engines are synchronised perfectly, and even then they are liable to get out of synchronisation of their own accord due to control creep and other things. The result of engines being out of synchronisation is an annoying "beat" which many people think for some unknown reason is confined to German aircraft. This "beat" is not only unpleasant for the crew, but it may set up vibration in the airframe.

The synchroniser consists of an alternator controlled by a knob in the cockpit which sets the governing speed to that required. The alternator is attached to one engine, and uses it as a master to control the speed of the other engines through the medium of an automatic engine-speed synchroniser which adjusts the pitch of the C.S. propellers to give the desired result.



THE MARTIN MARS, the world's largest flying-boat, was originally known as the PB2M-1, but in its new transport form is the JRM-1. In its final trials it flew 4,375 miles non-stop without re-fuelling in 34 hours 17 minutes. Powered by four 2,000 h.p. Wright-Cyclones, it can carry a load of about 15½ tons.

Airmanship

by String-bag

"*STAND by for ditching!*"

With the engine gone and the open sea beneath you, the moment has little to recommend it. But there are certain things that you can do—and this goes equally for your crew—which will minimise the chances of either drowning, starving, or spending the rest of your life without your front teeth. Every one of those things comes under the heading of "Airmanship," a quality which has been overlooked sufficiently often to contribute a substantial quota to the casualty lists.

Brains Trust

Before I took off for an exercise over the North Sea with pupil observers and air-gunners I always asked about half a dozen stock questions. The first question was: "How do you launch a dinghy?" The next one concerned the fire extinguisher and how it worked. Then the Rigger would climb up alongside my own cockpit and lay over my shoulders the two top straps of the Sutton harness. If the rigger was a stranger he would generally jump back to the ground and stand by the starter battery. But if he was my own rigger he always waited, and, without being told, adjusted the straps so as to pull me hard back against the seat. He knew that I shouldn't carry on starting the motor until this was done.

> **IN SHORT**
>
> The author, a Lieutenant Commander in the Fleet Air Arm, advises you to think ahead of the problems you will meet in flying and to check up on everything before the take-off.

Sign Here

Then the fitter would climb up after the engine had been warmed and the magneto switches tested, bringing with him Form 700 for signature. Instead of handing this over folded up he always gave it to me spread out, so that I could see along the whole length of the line on which I was signing. He knew that I should decline to sign it unless this was done.

This insistence on carrying out the letter of the law was not born out of any special respect for the flying regulations. The questions about the dinghy and the fire extinguisher owed their origin to figures I once saw on casualties due to bad ditching drill. The point about a tight Sutton harness was inspired by a friend who walked about with one side of his face flattened, the result of violent contact with the gunsight, which, in turn, was solely due to a slack harness and a crash landing.

Lastly, I never signed the Form 700 without looking at it carefully, after I had once found myself without oil pressure and only just within gliding distance of the coast. On that occasion the oil tank had not been refilled,

The crew of a DB-3F of the Red Air Force standing under the nose of their aircraft. They have made over 140 operational flights against the enemy and their targets include Berlin, Budapest, Warsaw and Prague.

This Bell Airacobra has been converted into a trainer for fighter pilots likely to fly tricycle undercarriage aircraft. The cockpit cover has been extended and nose armament removed.

although I had put my signature in the proper place and thereby accepted the aircraft as serviceable.

It may seem pedantic and unnecessary to labour such elementary points, but I have seen a good deal of pilots who have just finished their training and who are about to join operational squadrons for the first time. Many of them had not yet realised the consequences of slack airmanship and cockpit drill. They had been spoonfed, watched over by their instructors, and never had had any real responsibility of their own. Although the lessons had been dinned into them in the classroom, they still lacked the visual evidence of what happened if they were ignored.

This is not the place to teach the drill which you will be shown before many months have passed. But, as an old pilot, I can, perhaps, suggest that you take this part of your training as seriously as you will take your flying instruction.

The Careful Man

A short time ago I was invited by a Service friend to visit his station in the Midlands. We took off from a London aerodrome in a twin-engined aircraft, with the commanding officer himself at the controls. Now, this officer was an airline pilot before the war, with a national reputation, and if anyone could dispense with the elementary drill it was he. Yet I have never seen a more thorough check-up on instruments and controls than I did that afternoon. It actually included a full check of the blind-flying instruments, and this on a day when there was not a cloud in the sky. If a pilot of such experience deems it important to abide by the drill, how much more is it for the man who has only a few hundred hours experience? You will have guessed, of course, that the reputation of this officer was built on sound airmanship, and not only on his ability to fly through the overcast.

Faulty Drill

In three years of Service flying during this war I have seen many instances of faulty drill which have led either to disaster or to lucky escapes. It is no secret that flying accidents occur, and that nearly all of them are due to faulty judgment or faulty drill. There was the pilot who took off in a Fleet fighter without checking the friction screw on his throttle. As soon as he was off the ground he took his hand away from the throttle to raise the undercarriage. The throttle slipped back a couple of inches owing to the slack adjustment. The aircraft dropped a few feet, and the tip of the prop touched the runway, resulting in a damaged aircraft and a much chastened pilot.

In a formation practice above a shore station at which I was serving a rating in the back seat omitted to fasten his "monkey strap," and in addition to this threw back the sliding hood. Two aircraft in the formation came into slight collision, resulting in the leader's tail being tipped suddenly upwards, to be followed immediately by a steep dive. As little serious damage had been done, the pilot was able to right the aircraft after a few hundred feet and make a normal landing, but the rating at the back was shot out of the cockpit and made an unpremeditated descent without a parachute. The moral is obvious.

Carrying out a photographic exercise at 5,000 feet I found that the aircraft was both unstable and extremely sluggish in turn. It was so serious that I returned immediately to base and landed. In a few minutes I was complaining bitterly to what I thought must be an incompetent rigger. Without any comment this man reached down into the bottom of the cockpit and made a few adjustments to a handle which I didn't even know existed. This was a trimmer which applied aileron droop for dive-bombing, and it had been left full on. The only excuse that I had was that I was comparatively new to the Service and to this type of aircraft. It was really no excuse at all.

Start Thinking Now

I have said enough to drive home the point. It is quite likely that you will agree with every word of it, and even make good resolutions for the future. You will keep those resolutions until the moment you step for the first time into the cockpit of a Tiger Moth to begin your training. And then you may waver. There will be so much excitement and so many other things to remember, not merely now, but through every minute of your training, that the subject of airmanship may even take a back seat. Without doubt you will remember the principal points at your passing-out examination. But until you form the habit of applying them you are no more fit to call yourself a pilot than the non-flying personnel in your squadron.

A Trio of Test Pilots

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

IT is strange that test pilots, who, more than any other class of pilots, are responsible for the improvements in aircraft which make it possible to fly faster, higher and farther with greater safety, are the least publicised of all pilots. They receive few honours. Their years of highly skilled research work, often accompanied by moments of real danger, pass almost unnoticed in the aeronautical world, and are unknown outside it; whereas the pre-

Cyril Uwins, test pilot of Blenheims and other famous Bristol aircraft.

war record-breaking pilots who flew from one part of the world to another with a minimum of sleep had columns in the world's press, banquets, and often the decorations of numerous countries showered upon them. This was just one of the symptoms of the years between the two great wars when merit was measured by inches of newspaper space instead of by worth of work.

Interest and Interest

Way back in the dim and now distant history of aviation the first flight of a new type of aircraft used to be an event of sufficient importance to bring the directors of a British aeronautical firm from factory to tarmac to see it take the air. Its success meant much to their hopes of providing work in the factory; its failure meant months of gloom and scant profits. Gradually this personal aspect of aeronautical engineering died away. It went first in the United States. I remember one director of a British firm returning from the States and telling, almost with astonishment, that during his visit to one American aircraft company a new machine was going up for its first flight that day. He expected the president of the company to go out to the airfield to see the initial take-off, flight and landing. But, when the matter was mentioned, the American shook his head and smiled. That was the test pilot's business, he pointed out, not his. The test pilot was paid to do the job. The President's task was to deal with the finance of the company and its material progress, and that gave him no time to go out to airfields to watch an aeroplane fly.

Captain of the Team

But it is also logical that every pilot who flies should want to know something of the test pilots who first take into the air the prototype machines which later go into production and then become the mounts of hundreds of other pilots. Today teams of test pilots serve each big aircraft manufacturer where formerly there was perhaps only one pilot. But the teams are for the most part engaged in the testing of production aircraft. The handling of the prototypes is still the job of the few.

Uwins

One of the most skilled test pilots in the British industry is Captain Cyril F. Uwins, of the Bristol Aeroplane Co. Ltd. He was attached to the company during the Great War, after a crash which left him with a silver plate in his head and unfit for operational flying. But he has flown ever since. He took the world height record in 1932, in a Vickers Vespa fitted with a Bristol Pegasus engine, at 43,976 feet, without a pressure suit. I remember him flying the Bristol Pullman triplane early in 1920. There were seven passengers in this four-Liberty-engined job, among them the late Frank Barnwell, Bristol's designer, and the present writer, who happened to be at Filton that day. Filton aerodrome was not very big then, and "Cy" brought the big triplane down skil-

"George" Bulman, M.C., A.F.C., Hawker's test pilot.

fully with its wing-tips just brushing the tree-tops of the west boundary after a 25 minutes' flight. Soon afterwards came the Bristol racer, a fat-bellied monoplane driven by a Jupiter engine, with a retracting undercarriage whose wheels fitted into the body like the Wildcat's do today. Then followed a whole series of biplanes, including the Bulldog, and at last the now familiar series of Bristol monoplanes—the Blenheims and Beauforts. Cyril Uwins has been concerned with all of them, a wonderful record; he is probably one of the "safest" pilots in the world.

J. Lankester Parker, who tests Shorts aircraft.

Lankester Parker

Probably no one test pilot has done more for seaplanes than J. Lankester Parker, responsible for Short Brothers' test work for a great many years. The Empire flying-boats, the Sunderland and the Stirling are all among his test-flight productions. But he, too, has flown at the opposite end of the scale of sizes. One of his smallest types was the Short Mussel, a little all-metal, twin-float seaplane. Probably his biggest thrill was when he tested the Short-Mayo composite, with a seaplane mounted above the flying-boat, and so disposed as to attitude and weight that after the plug was pulled for the two to part company the seaplane would lift away from the boat. It did; in fact, it jumped about ten feet upwards when the lift came, just as "Bob" Mayo, its designer, prophesied it would. One of the quietest and most unassuming of men, no one would believe that Lankester Parker was the great test pilot he is by merely seeing him among a crowd of other men, except that there is just something in the character of his face which proclaims him to be a man who has done things which other men have not done.

Bulman

Then there is "George" Bulman, who joined Hawkers 'way back about 1925 or 1926, leaving the R.A.F. with the rank of flight lieutenant and the job of test pilot at the Royal Aircraft Establishment at Farnborough to enter the aircraft industry as a test pilot. Just why he is called "George" is a mystery, because his Christian names are Paul Ward Spencer. But everyone who knows him calls him "George." His name is associated with that of Mr. Sidney Camm, Hawkers' designer, as the test pilot who was responsible for the Hurricane, which began life as a private-venture all-metal monoplane experiment about 1935; Bulman flew it at Brooklands. Fury, Hart, Audax and Hurricane—these are the principal aircraft associated with the name of Bulman as test pilot. With the present war "George" was mobilised (he was a flight lieutenant R.A.F.O.), and he is now a group captain. He is almost completely bald, with a large head with a high egg-shaped crown, quite clearly crammed full of brains. He is small. His smile is infectious. He is a director of Hawkers, and probably commercially the most successful, and technically one of the most skilful, of British test pilots.

These three pilots are as different from one another to look at as three men could be, but they all have one attribute in common—a quiet, confident manner which comes from a lifetime of solving technical problems by the dual application of head and hands, for the crack test pilot is that rare type of man who is both a mental and a manual worker.

You MAY FIRE THE "SEVENTY FIVE"

AIRCRAFT armament took a logical but rapid step forward when the Mitchell B-25 medium bomber included the famous American 75-mm. gun in its offensive equipment.

Not so new to the American Army and those British tank crews who have handled the Seventy-Five in Shermans and Grants, this piece of ordnance (new term for the R.A.F.—includes any gun with a bore of over one inch diameter) has a bore of approximately 3 inches. A number of modifications must have been made to enable such a gun to be mounted in aircraft at all; but these are probably concerned mainly with the mounting and the projectile, leaving the Seventy-Five itself in normal form. Although little is obvious from photographs of the prototype, it appears that the gun depends for any wide traverse on the lateral movement of the aircraft.

Questions—and Answers

To the crews of big bombers, most likely to first contact the artillery of the air, the paramount question was that of operational handling. How would the big gun fit into the existing fire-control system? Would it require a separate gun-crew? What additional knowledge would they require?

The fire-control system practised between numbers of aircraft and within the machines themselves came into being early in the war as bomber crews found that a comprehensive use of their total armament proved far more effective than individual efforts from the different gun-positions. Brought to a fine art among the American daylight bombers, control of all fire-power by one man in radio communication with his team of air-gunners has played a vital tactical part in maintaining formation and repelling fighter attack from any quarter.

In the tanks, first fast-moving users of the big guns, we spot a similar system. The gunner, using a cross-wired telescope as his gunsight, is entirely dependent on the tank commander, with a bigger field of view, to make the target unmistakable and bring the gun to bear as rapidly and efficiently as possible.

Behind the Gun

What is required of the crew actually handling the Seventy-Five? Two men are needed to keep the gun in action, a gunner and a loader. In tank crews loading is the job of the wireless-operator, space shortage prohibiting additions to the crew, and wireless silence usually imposed when contact with the enemy is imminent leaves the wireless-operator conveniently free for the business. Wireless silence is not invariably imposed in the same way with aircraft, but it remains to be seen whether similar factors will make gun-loading a second trade for existing aircrew members.

Certain it is that the man behind the gun will have to be a skilled air-gunner. Previous knowledge will enable him to master the Seventy-Five rapidly, including in the training plenty of firing practice on the ground and in the air, working with the loader and fire controller (who will at first be his instructor) to form an efficient team.

It is not unlikely that he will spend most of the first period on a piece of training equipment the R.A.F. may borrow from the tanks, who in turn "won" it from the Navy. Called a "rypa" (the initial letters of its naval name—rolling, yawing and pitching apparatus), it will appear to airmen's eyes as a cross between the Link trainer and a fairground shooting gallery. The R.A.F. will doubtless find ways of adding to the already extensive repertoire of movement, in order to reproduce the unique manœuvres of an aircraft. Already the "rypa" will respond to the touch of buttons with any sort of movement that tank or naval gunners might possibly contact.

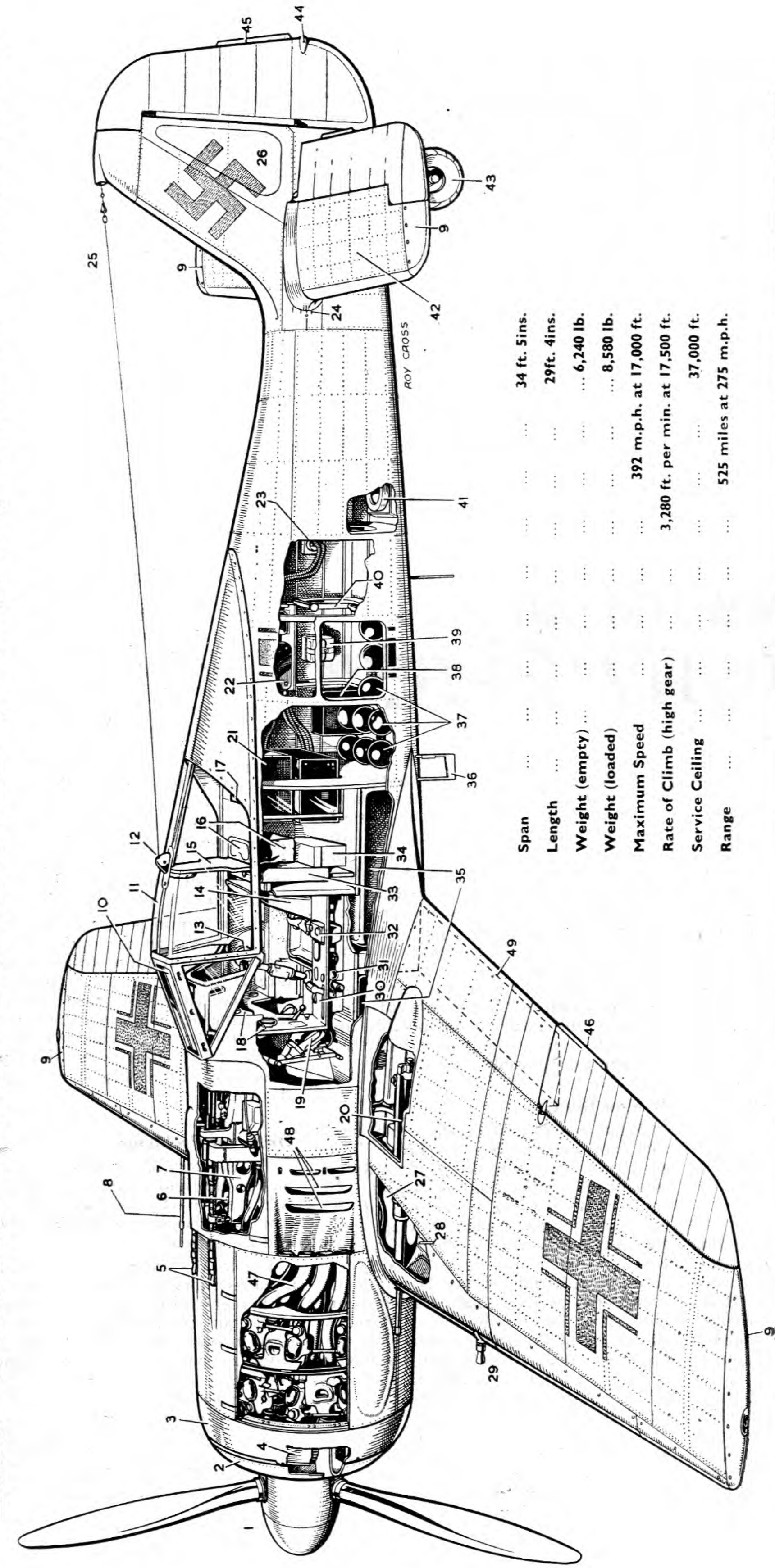
Firing airgun pellets from a full-size gun mounted in the open turret, and used in conjunction with a sand-table target, the "rypa" can reproduce the exact conditions of firing from a tank travelling nearly 40 m.p.h. over switch-back country at an enemy vehicle half a mile away, moving in the opposite direction. The only item missing is the noise.

Different Problems

In the air the various factors will have different values. Speed will count more—banks and turns substitute for the fiercer motion of tanks and rough seas.

Eventually mastering this new art, the air-gunner must become acquainted with mechanism, parts and stoppages of the gun, maintenance and operation. Easy to learn after the complex recoil-with-gas operation of the Browning and other machine-guns, the 75-mm. still comes under the "Q.F. and S.A." heading—quick-firing and semi-automatic action. Already maths-minded airmen will have little difficulty in grasping big-gun-firing theory—tangents of elevation, lines of sight and axes of bore.

The Focke-Wulf Fw190 A3 (One 1,730-h.p. BMW 801D Radial Motor)



Span	34 ft. 5ins.
Length	29ft. 4ins.
Weight (empty)	6,240 lb.
Weight (loaded)	8,580 lb.
Maximum Speed	392 m.p.h. at 17,000 ft.
Rate of Climb (high gear)	3,280 ft. per min. at 17,500 ft.
Service Ceiling	37,000 ft.
Range	525 miles at 275 m.p.h.

The Focke-Wulf Fw 190 above is "opened up" to show the very compact installation of engine, armament and equipment. In particular, the BMW 801 motor is neat, being contained in a low-drag cowling only 4.3 ft. in diameter, and having fan-assisted cooling. Experts consider that the Fw 190 is probably the best fighting aeroplane that the Germans have yet produced; it is certainly a fast, highly manoeuvrable and versatile machine, pleasant to fly and reasonably easy to service.

Main features of the A3 as drawn are as follows:

1, Variable-pitch VDM metal airscrew; 2, nose-ring of 5-mm. armour; 3, oil tank (10 gallons), protected by 3-mm. armour; 4, annular oil tank and oil cooler; 5, two synchronised 7.92-mm. guns; 6, hot air pipe for gun and ammunition heating; 7, gun-mounting; 8, pitot head; 9, detachable wing-tips; 10, bullet-proof windscreen; 11, sliding access hood (cannot normally be opened in flight, but may be jettisoned in an emergency); 12, aerial pulley (as hood slides back, slack of antennae is taken up over pulley, so keeping antennae taut); 13, sliding hood operating winch; 14, pilot's seat with 8-mm. armour back; 15, 14-mm. head armour; 16, ditty bag; 17, hood-jettison cartridge (breaks tubular guide and thus destroys hood anchorage); 18, double instrument panel; 19, rudder pedal actuates brakes; 20, Mauser 20-mm. cannon synchronised to fire through the airscrew; 21, radio transmitter and receiver; 22, electrical distributor panel; 23, external power-supply socket for engine starting, or testing instruments and services on the ground; 24, tailplane incidence gauge; 25, radio antennae; 26, access door to tail wheel retraction mechanism; 27, port wheel in "up" position; 28, undercarriage indicator (actually indicating wheels in "down" position); 29, Oerlikon FF 20-mm. cannon, one in each wing; 30, port switch panel (flaps, U/C, etc.); 31, warning horn; 32, priming pump and tank for engine starting; 33, 8-mm. back armour; 34, accumulator; 35, two fuel tanks of 115 gallons total capacity; 36, retractable footstep; 37, three oxygen bottles, each consisting of three connected spheres; 38, engine-driven radio generator; 39, first-aid package; 40, starting handle in stowed position; 41, Patin master compass; 42, adjustable tailplane; 43, semi-retractable tailwheel; 44, navigation light; 45, trimming tabs on rudder and on elevators; 46, aileron trimming tab; 47, exhaust pipes; 48, exit louvres for engine cooling air; 49, port split flap (shown dotted).

The FOCKE-WULF Fw 190

by Roy Cross

IN the autumn of 1941 several of the Fw 190s were shot down by R.A.F. fighters during the course of offensive sweeps over France, but they were not met in big numbers until some months later. There was no doubt that the new fighter was formidable, yet R.A.F. pilots soon found that low down and at high altitudes their Spitfires had a definite advantage over the German. The Fw 190 is at its best at around 17,000 feet, but at heights greater than 25,000 feet performance is not spectacular. British experts rate the Fw 190 very highly, and R.A.F. test pilots have voiced their admiration of the general handling and ease of control in the air, although the landing-speed is high.

The Fw 190 differs from other German fighters in several respects, chief of which is the fitting of a high-power BMW radial motor in place of the liquid-cooled in-line motors of the Me 109 series. Armament is heavier, as dictated by the new Luftwaffe policy of increasing generally the fire-power of service types, and the degree of electrification is high, for only the brakes and the variable-pitch airscrew are actuated hydraulically. Flaps, landing-gear, tailplane incidence and other ancillary services are operated electrically, in contrast to the wide-spread use of pneumatic and hydraulic systems in this country. A number of neat gadgets are incorporated into the design, including an engine master unit which automatically controls mixture strength, supercharger speed, boost pressure and the constant-speed airscrew; the jettisoning of the pilot's hooding by the firing of an explosive charge, and the extensive use of neat push-button switches in the cockpit. (*See drawing on this page.*)

Power Plant

A BMW 801D 14-cylinder two-row air-cooled radial motor with single-stage two-speed mechanical supercharger is fitted. Take-off power is 1,730 h.p. at 2,700 r.p.m., and the dry weight is 2,059 lb. The cowling is mounted directly on to the motor, so that the entire installation may be removed from the air-frame quickly and easily. A single-throttle lever controls the motor in conjunction with the master unit mentioned above; fuel is injected direct into the cylinders.

Behind the power plant is a fire- and fume-proof bulkhead, while across the rear fuselage is an airtight fabric screen, presumably to prevent air being sucked forward into the cockpit, causing a draught.

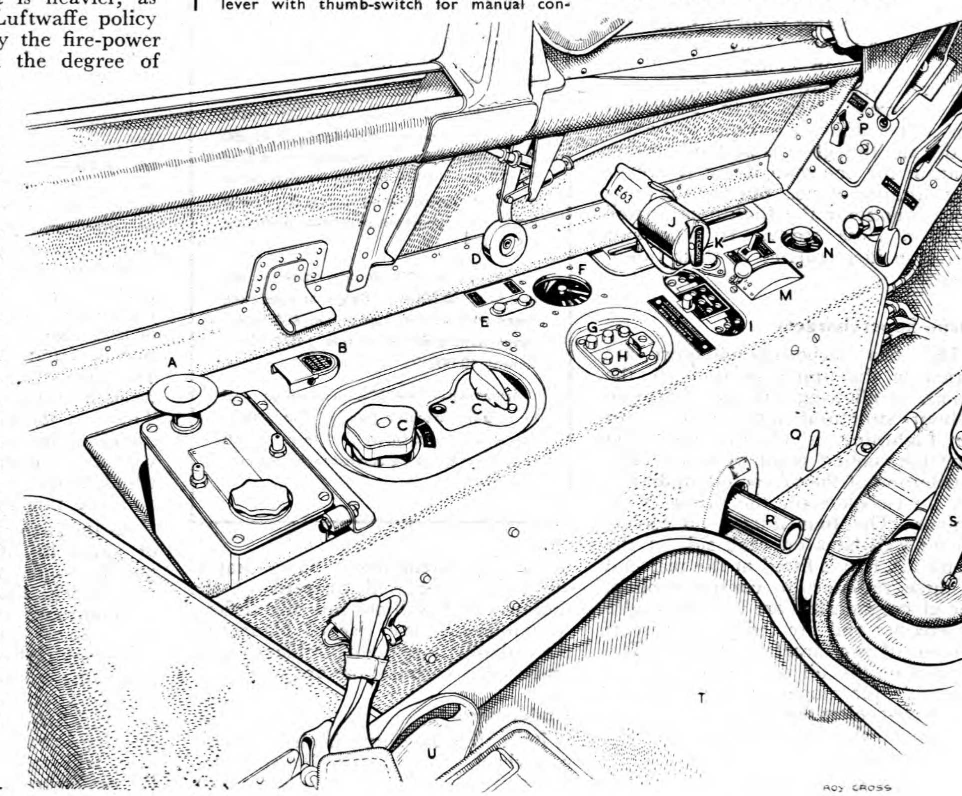
On the top of the engine are mounted two MG 17 rifle-calibre machine-guns (Rheinmetall-Borsig), and in each wing is one MG 151 20-mm. cannon (Mauser) and one MG FF Oerlikon 20-mm. cannon. Rates of fire are 600 r.p.m., 700-800 r.p.m. and 550 r.p.m. respectively On the control column is a selector switch allowing the following fire combinations—MG 17 and MG 151; MG FF; all guns. The total weight of fire of all guns is over 600 lb. per minute.

Armour is effectively situated cover-

CONTINUED ON PAGE 17

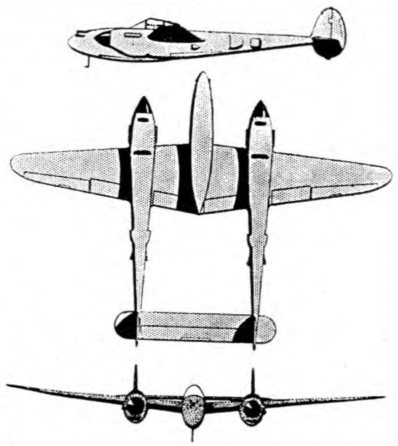
A view of the port side of the pilot's cockpit, which, though small, is remarkably well laid-out. The designers of the Fw 190 have made extensive use of press-button switches for operating the various services and equipment, arranging them either side of the pilot on neat switchboards.

In the drawing, A is the pump and tank for engine priming; B, W/T plug connector for pilot's helmet earphones; C, W/T volume control and "on-off" switch; D, tailplane incidence button-switches (press one to make aircraft nose-heavy and the other to make it tail-heavy); F, tailplane incidence indicator; G, flap and H, undercarriage switches; I, indicator lights for flaps and U/C; J, throttle lever with thumb-switch for manual control of airscrew pitch; K, main cut-out; L, selector switch, manual or automatic control of airscrew pitch; M, magneto switch; N, instrument light dimmer control; O, fuel tank selector lever; P, W/T switches; Q, release clip to allow removal of port switchboard; R, throttle damper; S, control column; T, pilot's seat and U, harness. Switches on the starboard side of the cockpit include those for bomb release, gun cocking, engine starting, master switch, navigation lights, instruments and W/T; a map case and scribbling block are provided, and on the cockpit wall are the sliding hood winch and hood jettison lever. A full range of instruments is fitted on the two dashboards.



The Lockheed Lightning

by **David Vine**



Power Plant—Two 1,150 h.p. Allison V-1710-27-F2 upright Vee liquid-cooled in-line engines, driving electrically-controlled three-blade airscrews.

Dimensions—Span 52 ft., length 37 ft. 10 ins., height 9 ft. 10 ins., wing area 328 sq. ft.

Weights and Loadings—Weight empty 11,170 lbs., weight loaded (normal) 13,500 lbs., maximum permissible overload 14,350 lbs., Wing loading at maximum overload conditions 44 lb./sq. ft., Power loading at maximum overload conditions 6.6 lb./h.p.

Performance—Maximum speed 360 m.p.h. at 18,000 ft. Range at operating speed with normal load of fuel, 600 miles; range with overload of fuel, 1,070 miles. Ceiling 40,000 ft.

Armament—One 20-mm. cannon and four .5-in. machine-guns. *Two 500-lb. bombs or two auxiliary fuel tanks of 150 gallons each, can be carried under the centre section.*

NOT only is the Lockheed Lightning unorthodox in appearance, but its entire layout is composed of many new ideas, some in the experimental stage, many quite well developed, others only new developments. Here is a short list of the unusual features that help to make this aeroplane one of the most advanced designs now flying:

1, Twin booms; 2, Fowler flaps; 3, turbo-superchargers; 4, nosewheel undercarriage; 5, all nose armament; 6, opposite-handed rotating engines driving outboard-rotating airscrews; 7, fully underslung engines; 8, twin engines for single seat; 9, four fully streamlined ducted oil radiators in the booms and inter-coolers for the turbo-superchargers set in the leading edges of the centre section. All these comparatively modern features are found separately on many modern aircraft now operating, but in no other aircraft are they all incorporated.

Escort Duties

The Lightning is one of the few aeroplanes designed specifically for providing an umbrella for high-altitude bombers like the Fortress and Liberator. Naturally, altitude protection has become, in day-bombing, a most vital safety factor, as enemy fighters can now operate at altitudes of 40,000 or more feet. The altitude of the Lightning is said to be 40,000 feet, though at a pinch it is probably 45,000 feet. Another specific advantage found in the Lightning is its long range, 1,100 miles, which makes it an out-and-back bomber protector. Its performance is excellent. It can climb like a Beaufighter, manœuvre like a Hurricane, and is almost as fast as the Mosquito. Nor is it a difficult aircraft to handle in the air, though it is probably rather a strain for one man flying it over a long distance alone. But for the aviation connoisseur the Lightning is well worth a close study. It represents American ideas carried to their fullest extent.

Turbo-Superchargers

The two turbo-superchargers are buried in the upper portions of the booms, so allowing full gas expansion without structural interference. But the Lightning is chiefly interesting from the cooling point of view. The distribution of the oil coolers, radiators and inter-coolers for the turbos is ingenious. The four ducted oil coolers are set well back on each side of the booms. A flap is fitted at the rear end of these radiators to control cooling. The glycol radiators are in front under the engines and are fed by two inlets in front of two circular radiators. The removal of the oil coolers to the rear has made for much cleaner cowlings. The inter-coolers for the superchargers are set in the leading edges of the centre section.

In front of the outer oil radiator ducts are streamlined barrel-shaped air intakes set well forward of the radiators and well out into the airflow, so minimising the risk of blanketing the radiator, a difficult problem where up-draught carburettors are used.

Undercarriage

Both the landing-wheels and the nosewheel are hydraulically retracted backwards, and are fully sealed by rubber-lined doors, which provide an unbroken under-surface when fully closed. This, of course, is a modern feature not now unusual, but contributing its small quota to the high speeds of today, which would be impossible without fully sealed apertures, as even the smallest crack disturbs the airflow and sets up turbulence at high speeds.

The long, unsupported high aspect-ratio tailplane has been a problem at the high speeds attained by this fast fighter—400 m.p.h. Flutter is the difficulty, but it has been overcome by the Lockheed designers, and now the only scars are two mass balances on the elevator. These, of course, do not necessarily imply a criticism, as many modern high-speed aircraft are fitted with external mass balances to minimise compressibility effects at ultra high speeds.

The Office

The cockpit gives the impression of a much bigger aeroplane. In fact, the cockpits of the Boston or the Mitchell seem very little bigger and hardly more roomy. Although the cockpit is crammed with instruments there is no bewilderment, owing to the well-thought-out arrangement. The control wheel is cranked to the right side, and provides much more leg-room than the centrally placed "stick" of most fighters. It has one disadvantage, however, and that is, it cannot be held between the knees. But when trimmed the Lightning flies "hands-off" and so allows the pilot some relaxation on long flights. Behind the pilot, and under a Plexiglas fairing, is the radio set, and, unlike many, it is accessible without a scramble.

Should the need arise, the front Plexiglas panel of the windshield can be jettisoned by pulling a handle just above and in front of the pilot's head. An unusual feature is the lack of ejection orifices for the 20-mm. cannon, so the spent cases are stored up inside the nose. No doubt a big sweep provides quite a lot of salvage. The four 0.5-in. machine-guns have ejector orifices, two on either side of the nose just in front of the nosewheel pivot. The nosewheel and main wheels have treaded tyres, and the track is wide. This and the nosewheel are partly responsible for the high initial ground velocity attainable by the Lightning, which helps greatly towards its truly amazing rate of climb at take-off.

As the Lightning has a load capacity of 3,000 lb., it is able to carry two 500-lb. bombs and still retain its full nose punch. This advantage was found of enormous value at Salerno and other places out of normal range of single-engined fighter protection. The Lightning is also carrying bombs into the European citadel. So now, with the U.S.A.A.F. daylight offensive increasing in tempo, the Lockheed Lightning will soon be as famous as the Flying Fortress.

On the left is a Lightning in flight, and beneath that a U.S. ground crew prepare to fit an auxiliary fuel tank. In the bottom left-hand corner a Lightning is towed past a Lockheed C-69 Constellation.

Below, an armourer re-loads a Lightning's guns.

1 CIRRO-CUMULUS forming out of a uniform layer of CIRRO-STRATUS. 25,000 ft.
2 CUMULUS in rapid growth, rapidly increasing in amount. Cloud type usually found in fine summer weather, beginning to form about 8 a.m. and reaching maximum development during early afternoon, thereafter dispersing again. 4,000 ft.
3 CIRRUS to CIRRO-STRATUS increasing in front of a depression. 30,000 ft.
4 Fine example of 'anvil' type of CUMULO-NIMBUS. Base falling in showers to leeward. Summit 12,000 ft.
5 High STRATO-CUMULUS cloud in waved bands. 7,000 ft.
6 Waves of ALTO-CUMULUS — the typical form of this cloud. 15,000 ft.
7 Tufted plumes of CIRRUS increasing in quantity. 30,000 ft.
8 CUMULO-NIMBUS during a thunderstorm. Summits about 12,000 ft. No 'anvil' showing.
9 NIMBUS in a line squall. Cold front. Height about 15,000 ft.
10 FURROWED STRATA. Rather infrequent. Less than 1,000 ft.
11 CUMULUS in long lines; the thermals used in gliding. 5,000 ft.
12 ALTO-STRATUS at 15,000 ft.

German Rocket Guns

THIS GUN fires six rockets in quick succession, each of which is ignited by a separate detonator. The Germans claim that it is the most formidable gun of the war, and that it has been used with much success on the Russian front. Guns similar in principle have been used against aircraft. Our massive daylight raids on the Pas de Calais are said to be directed against another type of rocket gun. The Russians have been using a similar weapon against Von Manstein's forces for quite a long time. It was referred to in the Soviet war communiqués as Katusha, or Little Katie.

Above is a rocket gun, with the crew of another in the background rushing forward to reload their gun. To right: one of the rockets leaves with a blinding flash.

What the CLOUDS foretell

by J. E. Dumbleton

ALTHOUGH the information necessary for an accurate weather forecast for 24 hours or more ahead is not now generally available, it is quite possible to make a reliable estimate of weather prospects over a period of, say, six hours by watching the cloud formation and general appearance of the sky. Certain cloud types are always associated with differing weather conditions, and the approach of bad weather usually accompanying an area of low pressure is nearly always preceded by a cloud sequence which, if correctly interpreted by an experienced observer, will indicate the character of the forthcoming weather.

It is necessary first to learn to distinguish between high, medium and low cloud, and also between heap and layer types, and then to watch the everchanging face of the sky to determine whether the cloud layer is tending to become higher or lower.

Very high, fibrous cloud, known as cirrus, at heights above 20,000 feet, usually denotes rainless weather for at least six hours, but if the cloud tends to thicken into a uniform transparent layer named cirro-stratus, partially obscuring the sun, you may begin to be suspicious as to the continuance of fine weather. If, at the same time, the wind "backs," i.e. changes direction counter-clockwise, you may reasonably assume that a period of rainy weather is likely to follow. It is quite likely that a "halo" around the sun or moon may be visible at this time, and shortly afterwards the cloud layer will probably thicken and form at lower heights into the type known as alto-stratus, through which the sun and moon are scarcely visible. Subsequently a further lowering of the clouds will be observed, until the sky is covered by nimbo-stratus cloud giving more or less continuous rain of varying intensity or, possibly, snow in winter.

Each of these clouds is of the layer type, formed by the rising of moist, warm air over a cooler layer, with consequent condensation of water-vapour to form rain clouds within medium heights and ice-crystal clouds in the higher layers.

Cirrus cloud is frequently the first indication of bad weather, simply because it is farthest from the centre of depression, and if the observer is on or near the centre-line of movement of the system a typical cloud sequence will be experienced. If, however, the observer is on the outer fringe of the low-pressure area, some distance away from the centre line, the appearance of cirrus in the sky will indicate only the presence of a depression in the vicinity and there will be no succession of lower cloud. Since depressions frequently travel across this country from south-west to north-east, it follows that cirrus cloud in the south or west sky often precedes rainy weather.

Cirro-stratus and alto-stratus cloud must not be confused with a low stratus cloud covering the whole visible sky, which may persist for days in winter with little or no rain, and is only the result of masses of tropical air passing over these islands after a long sea journey.

Clouds do not as a rule give such a reliable warning of the approach of fine weather in this country as of bad weather, for frequently the first indication of an improvement is the familiar break in the low-cloud formation, which quickly increases in height and probably changes to the heap type of cloud known as cumulus. The rain ceases, and within an hour it is perfectly apparent that fine, or at worst showery, weather will prevail for some hours. A succession of well-formed, detached, cumulus cloud will follow, probably becoming smaller and more dispersed, until finally the sky clears completely.

On fine, warm days in summer the same cumulus formation frequently occurs, but does not indicate any likelihood of a deterioration in the weather, although possibly some showers may be expected.

The familiar mackerel sky, with clouds of the type known as cirro-cumulus, is generally an indication of reasonably fine weather with a tendency to windy conditions. The clouds are of the layer type, with an appearance of tufted cotton-wool, in small, closely packed bundles. If somewhat lower, larger and rather more widely spaced, the cloud is named alto-cumulus, and can be regarded as an indication of fine weather for some hours.

Towering cumulus of the heap type are well known as almost certain to result in showery weather, and if the cumulus takes an anvil shape at a considerable height above a black, threatening base, thundery conditions can be safely foretold.

By such simple observation of the clouds it is quite possible to get a very good idea of the weather prospects, and at the same time a great deal of real pleasure can be derived from the wonderful cloud effects that are frequently seen.

THE FOCKE-WULF Fw 190

CONTINUED FROM PAGE 11

ing the engine and the cockpit. Two rings of 5-mm. and 3-mm. armour are at the front of the motor, 14-mm. and 8-mm. back and neck plates protect the pilot from the rear, and a bullet-proof glass panel is set into the windscreen. Electrical, fuel and air pipe connections indicate that either a large bomb or a long-range drop tank may be carried under the fuselage.

The Fw 190A4

An Fw 190 fighter-bomber has been used a great deal in recent months, particularly in the Mediterranean theatre, for assault upon our ground forces. As protection against fire from the ground, additional armour has been provided on the underside of the engine cowling and beneath the cockpit. The plates are about 6-mm. thick, and, probably to compensate for the extra weight of these and of the bomb load, in most cases the MG 17 and MG FF guns are removed. The combined 1,400-1,600 r.p.m. of the remaining MG 151 Mauser guns still give a weight of fire of 350 lb. per minute. With bombs slung from both the fuselage and wing racks, the A4 is a very potent offensive weapon.

An A5 version has recently been mentioned as in service, with a new wing and undercarriage. Other subtypes include an Fw 190 in which the slow-firing MG 17 fuselage guns are replaced by a more powerful weapon of approximately 13-mm. calibre, and a "bomber destroyer" model with gear under the wings for firing rocket-propelled projectiles into tight formations of Allied heavy bombers in an attempt to break up such formations, and allow waiting German fighters to pounce on the scattered bombers.

Books

UNOFFICIALLY REVIEWED

Air Training Manual

By collected authors. Odhams Press. 7/6. 320 pages. 5¾″ × 8½″. Illustrated.

This book, addressed to the A.T.C., is a collection of eight essays by seven specialists on aero-engines, airframes, radio, navigation, gliding and mathematics. There is something to interest everyone, with nearly 100 pages of excellent line drawings. The text is informative and up-to-date (the Merlin XX is described). Containing a wealth of detail, this solid book is most warmly to be recommended.

Air Cadet

By Alfred Kerr. Pendock Publication. 128 pages. 4½″ × 6″. 59 diagrams.

Younger cadets may find interesting the brief notes on elementary aerodynamics, navigation, map-reading and the compass. The section on Trigonometry, with logarithm tables, is perhaps the most valuable, but the chapters on Aerobatics and Rules of the Air are too compressed to be useful. At the end is a poor aeronautical glossary.

Clouds

By C. J. P. Cave. Cambridge University Press. 5/-. 22 pages. 5″ × 7½″. Illustrated.

The latest edition of this attractive little book has not been written primarily for the A.T.C. The short text describes cloud formation, sky colours and other sky phenomena only in a general way. A note on condensation trails does not explain wing-tip trails. There are 42 magnificent cloud studies, but one misses a really good "anvil" cloud photograph.

Illustrated Calculations for the A.T.C.

By T. H. Ward Hill, M.A. George Harrap. 3/-. 110 pages. 5″ × 8″. 98 diagrams.

Fractions, decimals, squares, ratio, areas, algebra, equations and graphs are explained amusingly yet firmly by word-pictures using aeronautical subjects wherever possible. Each section ends with practice tests and answers. This book is a valuable contribution by a well-known mathematician.

R. G. Worcester.

Handbook of English

By C. P. Rawson, M.Sc., Ph.D., and S. G. Saunders, L.R.A.M. George Allen & Unwin Ltd. 2/6. 108 pages. 4⅛″ × 6½″.

The importance of writing good English becomes obvious when reports have to be written—and read without misunderstanding. This booklet points out several pitfalls which a cadet should avoid. It is a pity that in the section on Spelling, the Albacore and Fulmar should suffer vowel mutilation on page 22.

Over to You

Stationery Office. 9d. 112 pages. 4¾″ × 7⅛″.

Thirty-two new broadcasts made anonymously by various members of the R.A.F. with practical operational experience are presented in readable form as a Ministry of Information booklet. These sidelight accounts make good mixed reading, and give the human touch to events which have made headlines in the world's press. Recommend to be read in small doses, for the words that sound well in a broadcast have freqnently an odd appearance when set down in reading form.

Cloud Cover

By Derek Gilpin Barnes; illustrated by A. K. Lawrence, R.A. Rich & Cowan. 12/6. 176 pages. 5¾″ × 9″.

Most personal narratives of the war scene race along. These recollections of an R.A.F. intelligence officer proceed at a pleasant amble. Deep sympathy will be extended, surreptitiously, by many seniors for the author's confession of fear of small boys who ask him questions about aeroplanes.

Bombers Fly East

By Bruce Sanders. Herbert Jenkins Ltd. 8/6. 186 pages. 4¾″ × 7¼″. Illustrated.

Colourful accounts of R.A.F. star actions that cannot fail to excite and thrill, partly because of the aggressive writing, partly for the background information to well-known events. Official stories have been knitted with the author's own versions, the result being often two plain and one pearl.

A Guide to Courts-Martial Procedure

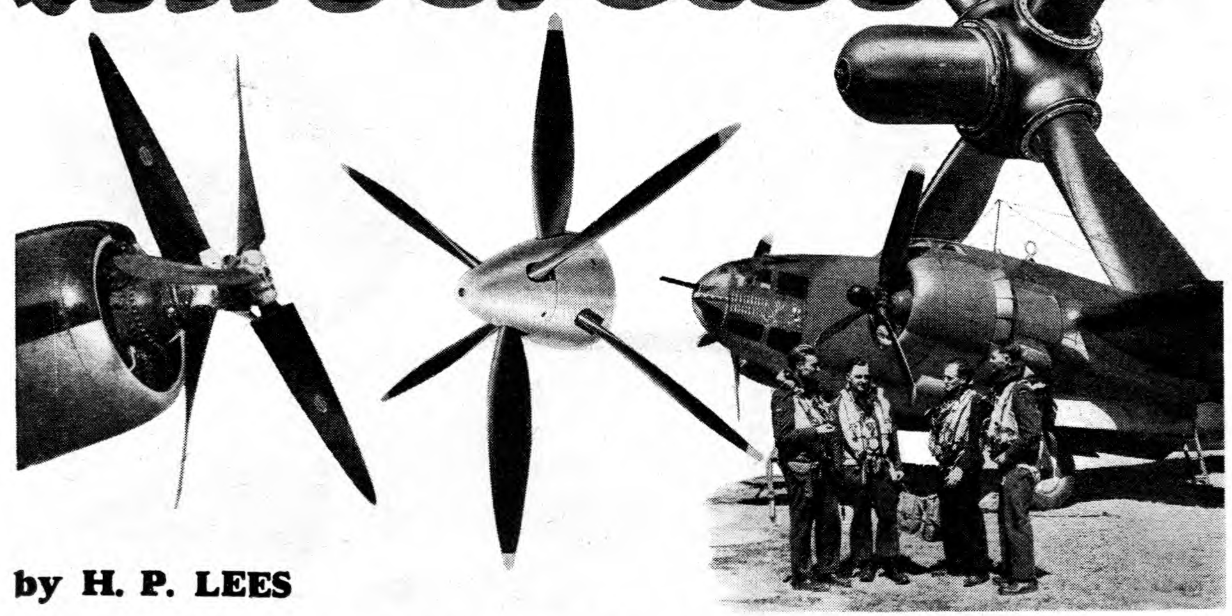
By Squadron Leader L. J. J. Pullar, M.C. Sifton, Praed & Co. Ltd. 5/6. 111 pages. 4¾″ × 7¼″.

The intricacies of court-martial procedure in the R.A.F. are here unravelled, the book providing a clear picture of events from arrest to sentence. This, the fourth edition, will aid those deputed to sit in judgment and those who come for trial. For some inexplicable reason the book opens east-west and is printed at right angles to the direction of opening, instead of the normal north-south convention—perhaps to show that the layman must re-orientate his outlook in the presence of the law.

B. J. Hurren.

Coastal patrol.

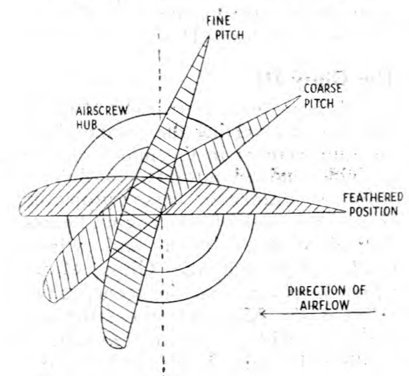
Airscrews



by H. P. LEES

An airscrew obtains the thrust which propels the machine forward by imparting a rearward acceleration to the slipstream.

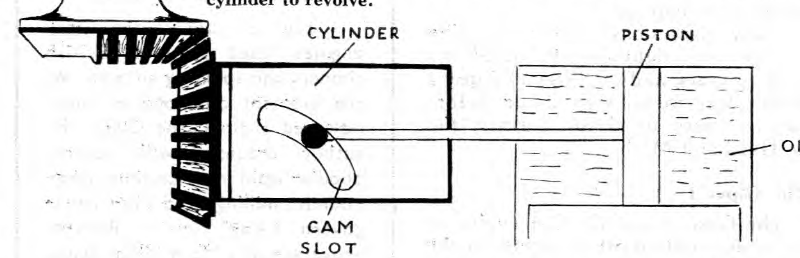
The blades, of which there may be two, three or four, are set at an angle formed between the blade and an imaginary surface to which the engine shaft is perpendicular. The angle is greatest at the hub end of the blade, and decreases towards the tip. At any point along the blade the cross-section of it is similar to the cross section of a mainplane. As the airscrew revolves, the tips of the blades have a greater



rotational speed than the inner portion near the hub, so to keep the efficiency of the blade at its highest the blades are twisted towards the tip. As the airscrew meets the combined airflow—that is, forward and rotational—lift and drag are created by the blade having aerofoil section. This lift, when applied to an airscrew, is termed "thrust," and the drag "torque."

The choice of the number of blades for an airscrew depends on the type of machine it is fitted to and the power of the engine. Two blades are generally sufficient for low-powered aircraft but, as the power increases, three, four, or more are used in order to obtain the maximum efficiency with a reasonably small diameter

Method of altering airscrew pitch. A control in the cockpit drives the oil under pressure to either side of the piston. Piston operates a cam in a cam slot which causes cylinder to revolve.



To obtain the best results from an airscrew a variable-pitch airscrew is used. During take-off or climbing a fine pitch is best, because it allows the engine to develop a higher speed and give more horsepower. For cruising conditions, when the machine is airborne, a coarse pitch is better. If for any reason an engine stops during flight through a mechanical failure the airscrew would continue to rotate or windmill, because of the action of the airflow on the blades. If the engine had stopped through a minor internal fault, this windmilling would make it develop into a serious breakage because of the constant turning of the cranks, and possibly result in the engine becoming a "write-off." To avoid this happening, and also to cut down the drag which a windmilling airscrew causes, the controllable-pitch airscrews are fitted with a device which allows them to be turned edge on to the direction of flight. This is known as feathering the airscrew.

Most modern high-powered engines have a reduction gear fitted between the engine and the airscrew, which allows the airscrew to turn slower than the crankshaft. Reduction-gear ratio refers to the ratio between the crankshaft speed and the airscrew speed. Doing this enables a more efficient airscrew to be used by cutting down the speed of the blade tips and yet absorbing the full power of the engine.

WAR tends to get our ideas on many things badly out of perspective, and those of us who are connected with flying are rather apt to take for granted aircraft with massive engines, and to forget that the vast majority of flying after the war will be done in aircraft with engines of under perhaps 300 h.p.

Gipsy engines have played a leading part in the light-aircraft world for over 15 years, and the original Gipsy I design was to be seen flying before the war with its classic partner, the de Havilland Moth.

The Gipsy I

The Gipsy I was the first engine in the series, and all other engines in the family have been logical developments. It was a four-cylinder, vertical, air-cooled engine developing 98 b.h.p. at 2,100 r.p.m. It was of very simple design; it had no reduction gear and weighed about 280 lb. Its power-to-weight ratio was poor judging by present-day aims of 1 lb. per h.p. for operational military aircraft, but its purpose was a very different one. Throughout the Gipsy family a tradition of reliability has been combined with low cost.

The Gipsy II

The Gipsy I, which was used in several light aircraft, soon had a development in the Gipsy II. This engine was the stepping-stone between the normal engine practice of having the cylinders mounted on top of the crankcase, as in the original Gipsy, and the practice in Gipsy engines subsequent to the Mark II of inverting the engine.

> **IN A NUTSHELL**
>
> A brief account of the Gipsy engines fitted to most British trainers and sporting aircraft. At the moment outshone by high-powered engines, the Gipsy, the author predicts, will become popular again in peace-time, when pounds, shillings and even pence govern flying time. Pictures above are of a Moth Minor (two-seat trainer), a Gipsy Minor engine, and a Percival Q6 (Petrel) twin-engine light transport.

A little heavier than the Gipsy I, the Gipsy II had dry-sump lubrication and valve gear working in oil baths, and developed about 120 b.h.p. In addition to being used in Moths and various other light aircraft, the Gipsy II was installed as the port and starboard engines in the Airspeed Ferry which, amongst other things, used to do yeoman service on the mainland to Isle of Wight service. The third, centrally mounted, engine on this aircraft was a Gipsy III.

The Gipsy III

This is merely an inverted Mark II. The act of inverting the engine allows an improvement in the pilot's view in a single-engined aircraft, as there is only the crankcase cover projecting above the level of the engine bearers instead of the cylinders and cylinder heads. Although the Gipsy Major, which next came on the scene, rather eclipsed the Mark II, the latter was used in a wide variety of aircraft, including the Puss Moth, Miles Hawk, Spartan three-seater, Spartan Cruiser and the tiny Comper Swift.

The Gipsy Major

One of the most popular engines in the family is the Gipsy Major. Generally similar, except for the lubrication system, to the Gipsy III, it develops 130 b.h.p. and weighs a little over 300 lb. The Major has been used in at least 28 aircraft, amongst which are the little Saro Cutty Sark flying-boat, the B.A. Eagle, the Miles Hawk, the Miles Falcon, the Miles Whitney Straight, the Miles Monarch, the de Havilland Dragon, the Leopard Moth, the Fox Moth, the de Havilland Dragonfly, the Hornet Moth, the General Aircraft Cygnet, and, of course, the Tiger Moth. Notable among these is the Fox Moth for weight carrying and seating arrangement. In this single-engined aircraft the pilot sits in a cockpit some little way to the rear of the mainplane. Forward of him the fuselage swells, and can accommodate four passengers in a little cabin between the wings. The Cygnet is interesting, being the first British light aircraft to have a tricycle undercarriage and almost the first to have metal stressed skin. More might have been seen of it but for the war.

A few Gipsy Majors, series II, were made with provision for the fitting of a V.P. propeller. The two most notable aircraft to have this engine were the T.K.2 and the T.K.4, special low-wing racing monoplanes designed and built by students of the de Havilland technical school. The latter, which was of minute dimensions, had a top speed of 230 or 240 m.p.h.

The Gipsy Six

A departure from the original Gipsies, the Gipsy Six has six cylinders. The magnetos are mounted on the crankcase cover instead of the rear cover of the engine. It develops a little over 200 b.h.p., and weighs about 430 lbs.

This engine has probably made more aeronautical history than any other engine outside the R.A.F. Anyone who was lucky enough to be on Mildenhall aerodrome at dawn one autumn morning in 1934 will never forget the de Havilland racing Comets with special Gipsy Sixes disappearing in a slow turn on to a course a little south of east. Seventy-one hours later Scott and Campbell Black brought their Comet into Melbourne airport to win the MacPherson Robertson Trophy.

Accomplishments such as this, in which the Sixes were run for days on end, often close to full throttle, followed in quick succession until the outbreak of war.

The Six during the pre-war years was also doing continuous and unspectacular work in air transport, and will undoubtedly continue to do so after the war.

An inverted-vee engine, the Gipsy Twelve, was produced in 1938. Basically it was two Gipsy Sixes. It was installed in the Albatross (DH 91), and thanks to this aircraft's almost perfect aerodynamic qualities the four Gipsy Twelves with their power of a little over 400 b.h.p. each made it go remarkably fast.

The last pre-war engine by de Havilland was the Gipsy Minor. It was a four-cylinder inverted engine of about 90 b.h.p., and was remarkably compact. It did not have a chance to prove itself before the war came along, but it seemed to be very happy flying in the new Moth Minor, a low-wing monoplane. Undoubtedly it should have a place in post-war aviation.

And now the Gipsy Supercharged Six is announced. Weighing about 550 lb., and developing perhaps 300 b.h.p., it should, with the experience that de Havillands have accumulated on the ordinary Six, make for some interesting flying after the war. The supercharger is of the centrifugal type, and since the engine is provided with automatic boost controls, and a C.S. propeller is fitted, it will be possible to train pilots to advanced engine technique at an early stage.

Key to Tails and Details

(See page 24)

1, Bell Airacobra; 2, Consolidated Liberator; 3, Westland Lysander; 4, Douglas Dakota; 5, Messerschmitt Me 323; 6, Blohm and Voss Ha 139; 7, Northrop N-3PB; 8, SB-2; 9, Curtiss Seamew; 10, Piper Cub; 11, Vought-Sikorsky Chesapeake; 12, North American Harvard; 13, Consolidated Catalina; 14, Grumman Avenger; 15, Grumman Hellcat; 16, Avro Anson; 17, Handley Pages Halifax II Series I; 18, Martin Mariner.

Key to Name Please!

(See page 3)

1, Lockheed Lightning; 2, Republic Thunderbolt; 3, Douglas Dakota; 4, Junkers Ju 88; 5, Martin Marauder; 6, Heinkel He 111; 7, Grumman Goose; 8, North American Mustang; 9, Kawanishi H-97-1 (Mavis); 10, de Havilland Mosquito; 11, Short Stirling; 12, Percival Proctor; 13, Curtiss Helldiver; 14, Douglas Digby; 15, Hawker Hurricane; 16, Brewster Buffalo; 17, Douglas Dauntless; 18, North American Mitchell; 19, Vought-Sikorsky Kingfisher; 20, Grumman Wildcat; 21, Boeing Sea-Ranger; 22, Martin Maryland; 23, Martin Mariner; 24, Avro Anson; 25, Supermarine Spitfire; 26, Martin Baltimore; 27, Handley Page Halifax; 28, Consolidated Catalina; 29, Bristol Blenheim IV; 30, Avro Lancaster I.

Flight Lieutenant W. Reid, V.C.

DURING a fight with a Messerschmitt Flight Lieutenant Reid was wounded in the head, shoulders and hands. The elevator trimming-tabs of the bomber were damaged and it became difficult to control. The rear turret, too, was badly damaged and the communications system and compasses were put out of action. Flight Lieutenant Reid ascertained that his crew were unscathed, and, saying nothing about his own injuries, he continued his mission.

Soon afterwards the Lancaster was attacked by a Focke-Wulf 190. This time the enemy's fire raked the bomber from stem to stern. The rear gunner replied with his only serviceable gun, but the state of his turret made accurate aiming impossible. The navigator was killed and the wireless operator fatally injured. The mid-upper turret was hit and the oxygen system put out of action. Flight Lieutenant Reid was again wounded, and the flight engineer, though hit in the forearm, supplied him with oxygen from a portable supply.

Flight Lieutenant Reid refused to be turned from his objective, and Dusseldorf was reached some 50 minutes later. He had memorised his course to the target, and had continued in such a normal manner that the bomb-aimer, who was cut off by the failure of the communications system, knew nothing of his captain's injuries or of the casualties to his comrades. Photographs show that when the bombs were released the aircraft was right over the centre of the target.

Steering by the Pole Star and the moon, Flight Lieutenant Reid then set course for home, and, despite a temporary lapse into semi-consciousness, with the assistance of the flight engineer and the bomb-aimer accomplished the North Sea crossing. Just after sighting a home airfield Reid resumed control and landed safely.

Variation of Trail Angle

By Squadron Leader W. R. ACOTT, D.F.C.

IT is known that the trail angle of a bomb varies with the airspeed of the bombing aircraft. This is due to the varying air resistance encountered by the bomb when it is released from the slips.

The bomb travels forward through the air because it has kinetic energy, or energy of motion given to it by the aircraft. As it passes through the air it displaces a mass of air. The air mass moved acquires kinetic energy at the expense of the energy possessed by the bomb. Kinetic energy is the work accumulated in the bomb, and is the product of its weight and speed. Since the weight of the bomb is constant, the velocity must decrease with loss of kinetic energy.

The greater the airspeed of the bombing aircraft the more rapidly will the kinetic energy of the bomb be lost to the suroundiing air in overcoming resistance. The air resistance encountered by the bomb can be calculated from the following formula:

$$\text{Resistance} = K_R \rho A V^2$$

where K_R is the coefficient of resistance of a particular shape of bomb. It may be found by experiment on scale models in the wind tunnel.

ρ is the density of the air, which is mass per unit volume. Air density is slugs per cubic foot.

A is the frontal area of the bomb in square feet.

V is the velocity of the bomb in feet per second.

For a given bomb there is only one variable, that is, V. It will be noted that in the formula V is squared. Double the speed of the bomb, and the resistance to its motion is four times as great.

Consider two identical bombs launched from separate aircraft; bomb "A" is released at 300 m.p.h., bomb "B" at 150 m.p.h. The kinetic energy

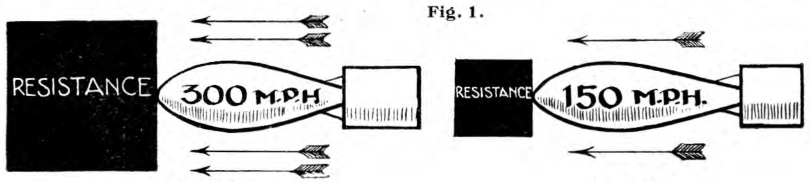


Fig. 1.

Bomb A. Bomb B.

(indicated by arrows in Fig. 1) of bomb "A" is twice that of the slower bomb "B." Their weight is equal, but bomb "A" is travelling twice as fast.

Returning to the formula—

$$R = KV_R \rho A V^2.$$

For identical bombs $K_R \rho$ A will be the same. Let us substitute for these three symbols one symbol, X.

Then the resistance to motion of bomb "A" will be $X \times 440^2 = 193{,}600$ X pounds, and bomb "B" $X \times 220^2 = 48{,}400$ X pounds. Bomb "A's" motion is being resisted by a force four times as great as the resistance encountered by bomb "B," and it has only twice as much kinetic energy with which to deal with this force. The loss of kinetic energy and, consequently, the trail angle will be greater.

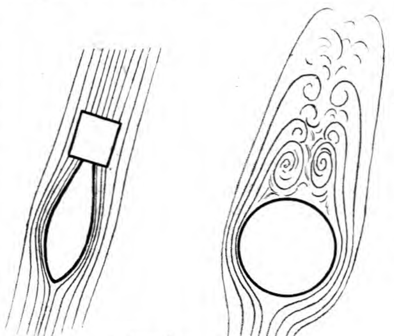


Fig. 2.

Since it is now known that the kinetic energy of a bomb is lost imparting kinetic energy to the body of air which it displaces, it follows that a streamlined bomb, since it displaces less air, will not lose energy so rapidly as a bomb of poor shape.

Fig. 2 shows the different effects on the surrounding air mass of a streamlined bomb and a round object of similar weight and volume. The more perfect the streamline the smaller the mass of air pushed aside by the bomb. An unstreamlined body leaves a large mass of disturbed air in its wake. Air which is set in motion by the bomb has received its energy at the expense of the bomb.

In Fig. 2 bodies of similar weight and volume are compared in a streamlined and unstreamlined condition. Suppose two bodies of similar shape but of different weight and volume are travelling through the air, which will decide the rate at which they will lose their energy of motion?

A simple comparison would be a cricket-ball and a football. Both, we will assume, are given the same velocity to begin with. The football causes a fairly large displacement of air, far larger than the cricket-ball. Its rate of loss of energy to the air will be high. The cricket-ball, having smaller volume, displaces a smaller mass of air, therefore its rate of loss of energy is lower.

The cricket-ball, given the same velocity as the football at the outset, will lose its velocity less rapidly. This is because its density is greater; it has greater mass per unit volume. The greater the density the smaller the volume in which energy is stored, the smaller the displacement of air and consequent loss of energy to the air.

The reasons for the loss of forward velocity of a bomb have been discussed. What of its downward velocity?

Taken to height by the aircraft, it has acquired potential energy or energy of position. As it falls under the influence of gravity it is accelerating and the potential energy is changing to kinetic energy. On impact with the ground all its potential energy has been converted into kinetic energy. As potential energy there was no loss, but kinetic energy is lost to the surrounding air. The bomb will accelerate downwards until the increasing kinetic energy due to loss of height is equalled by the loss of energy into the displaced air. At that point the bomb will have reached its terminal velocity.

Fig. 3 illustrates three positions of a bomb during its fall, at one second,

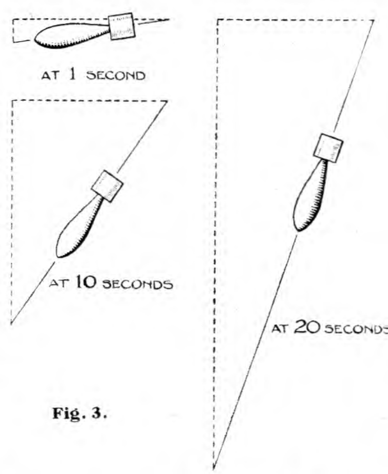


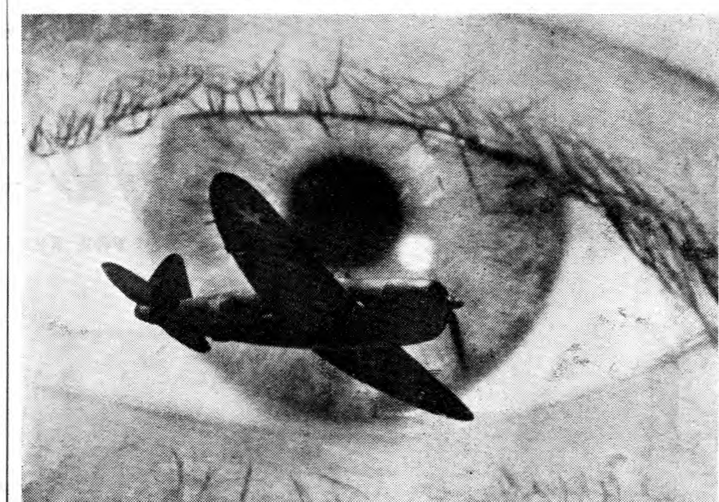
Fig. 3.

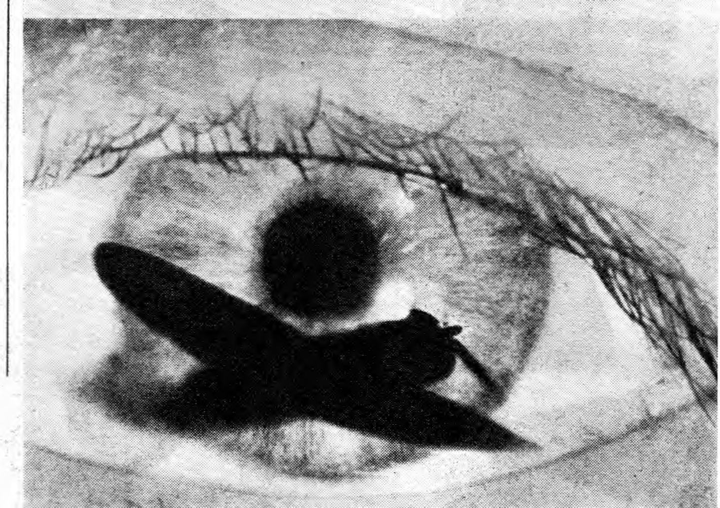
ten seconds, and 20 seconds after release from the aircraft. It will be noted that the velocity attained due to gravity eventually preponderates over the velocity imparted to the bomb by the aircraft. The longitudinal axis of the bomb slowly inclines to the vertical. It never attains a fully vertical attitude, as the forward velocity is never entirely lost, unless it is dropped from astronomical heights.

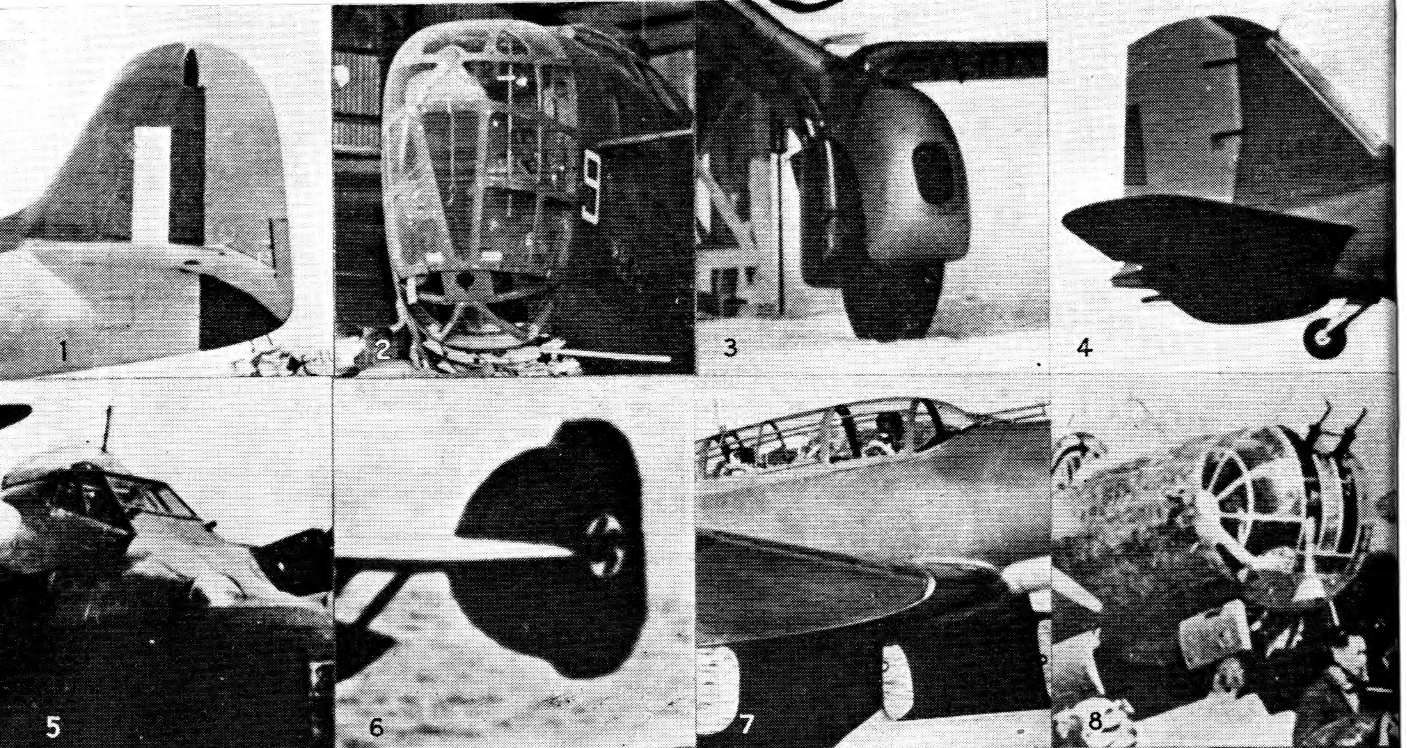
The lower the airspeed of the bombing aircraft the smaller is the horizontal vector and the more quickly does the bomb turn towards the vertical.

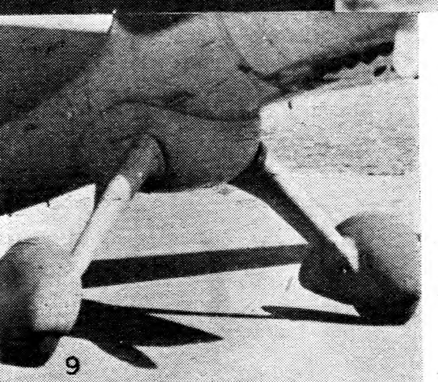
What the Trained Eye Sees

The U.S. Army Air Force operates a special "Eye School" in which pupils are allowed one one-hundredth of a second to identify any plane flashing across a screen. The method is, it is found, better than the old silhouette study method. The upper picture of the eye shows how an aeroplane appears to the trained eye of the recognition school graduate. He sees all of the plane from tail to prop. Lower photo depicts what the untrained eye sees in the sky . . . blurred tail, half a prop and a disappearing wing.



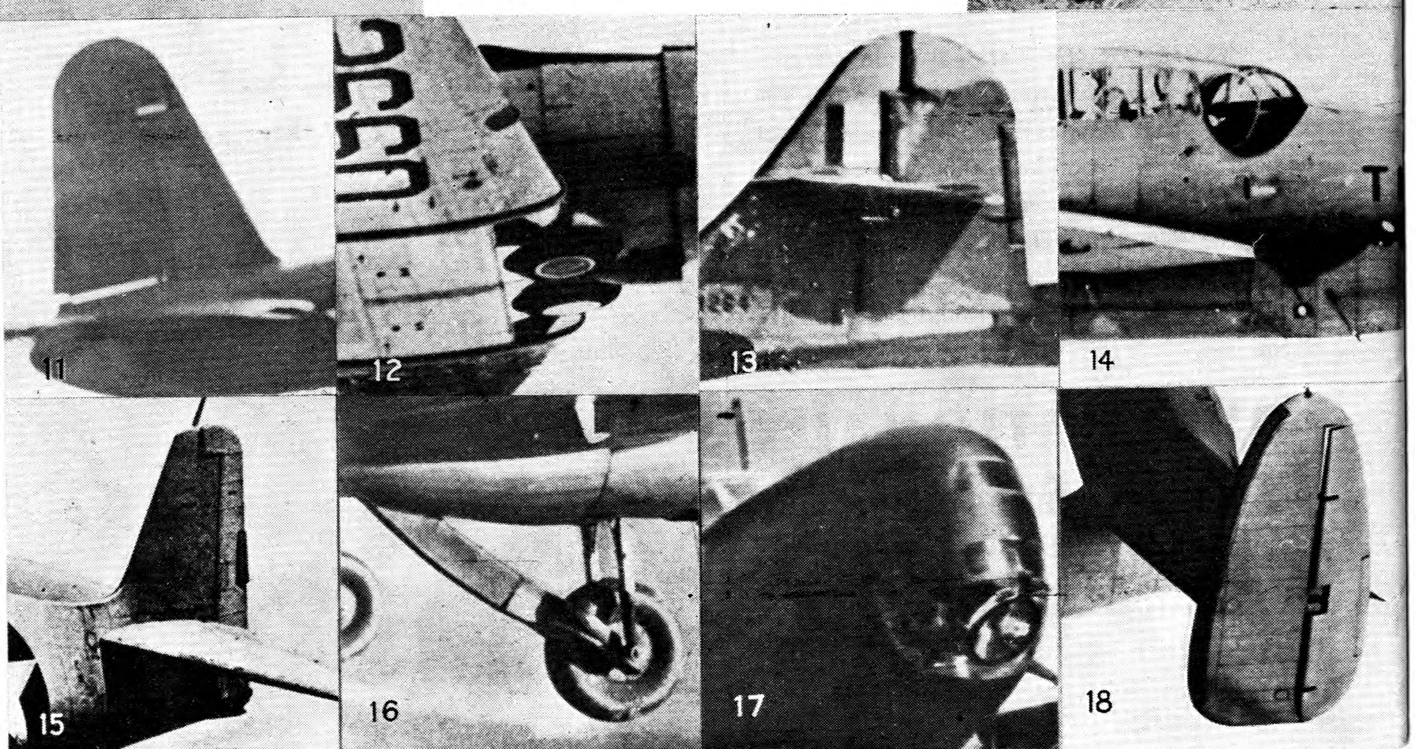






Tails and Details

FOR KEY see PAGE 21



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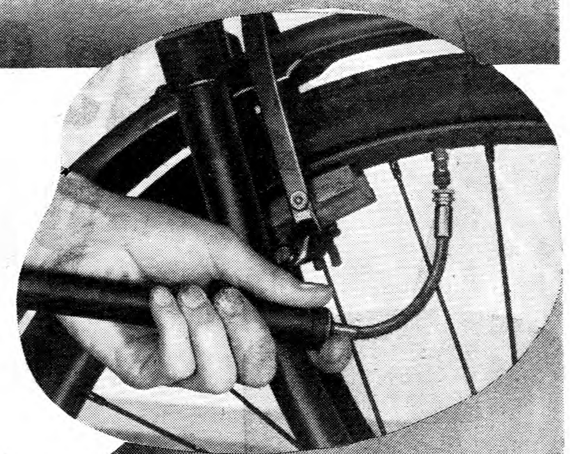

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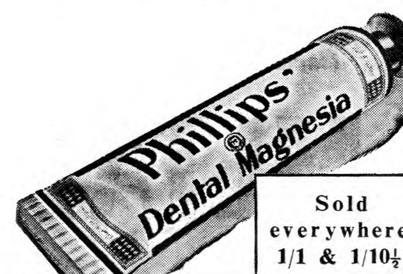

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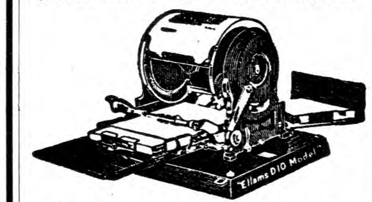

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A Catalina in the harbour of one of the mountainous Aleutian Islands in the North Pacific.

A Cat alights beside a seaplane tender in the harbour.