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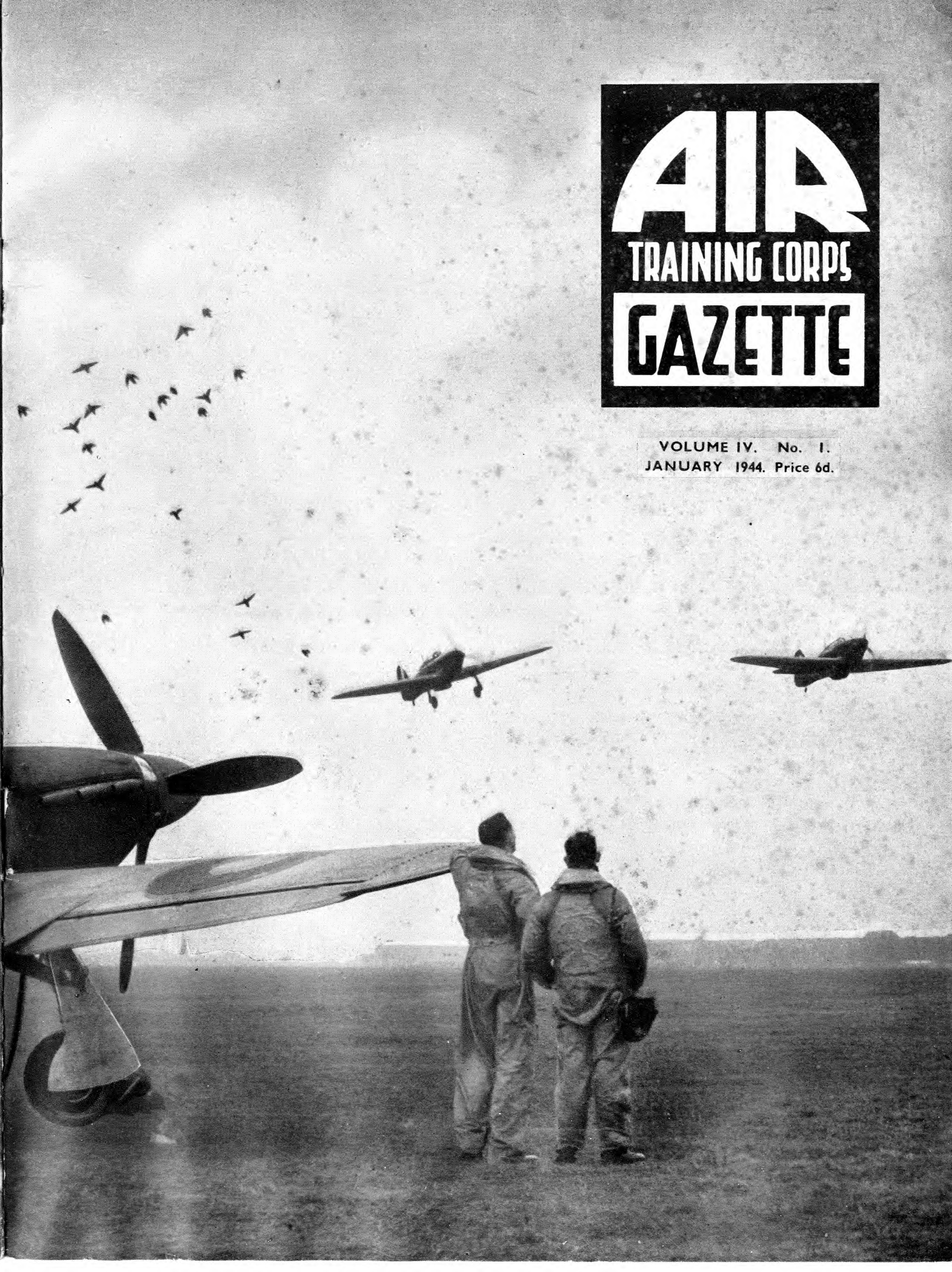
Colin Hinson
In the village of Blunham, Bedfordshire.



AIR TRAINING CORPS GAZETTE

VOLUME IV. No. 1.
JANUARY 1944. Price 6d.

A U.S. Navy photographer 'shoots' a Grumman Hellcat as it takes off during a demonstration in New York.

A Douglas Skytrooper of the U.S. Naval Air Transport Service flying above a sea of clouds and passing the Caroli Volcano in the Aleutian Islands.

VOL. IV NO. 1
JANUARY 1944

Edited by Leonard Taylor

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AIR TRAINING CORPS GAZETTE

GOOD WISHES

WE are entering upon a new year and my first and pleasant task is to wish you all "A Very Happy New Year." With this good wish I would couple my congratulations to you on all that has been effected.

In the old year we began to see clearly the results of your efforts in the tens of thousands of young men entering the Royal Air Force, many arriving at the stage of operational flying; we won a V.C. and other honours. I am sure that every one connected with the Corps feels repaid for the great amount of work put into it.

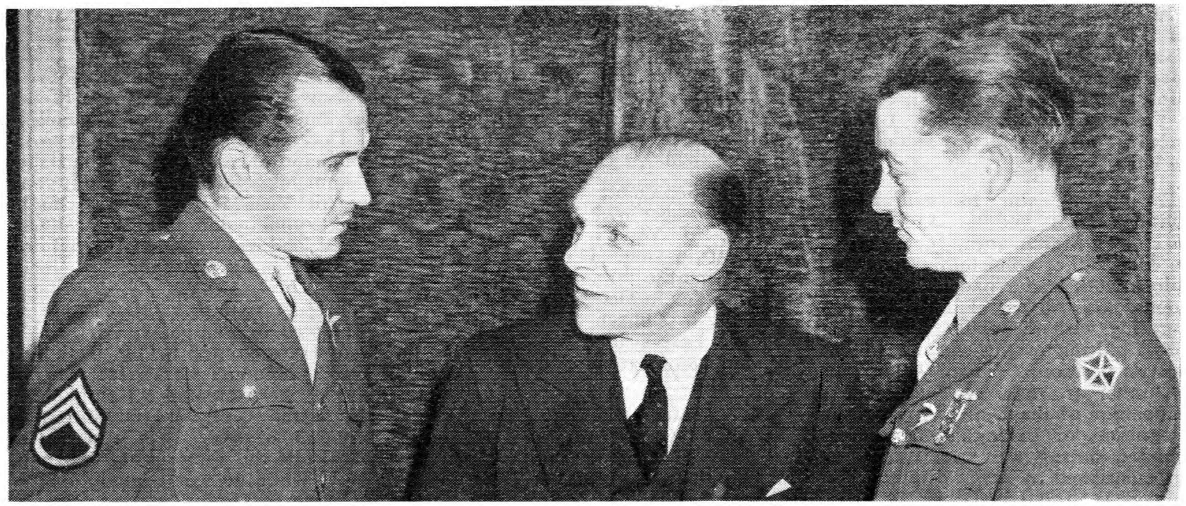
The year which we are entering is likely to be a year of change. Great things will happen in the World War and the Corps will not be unaffected by the changes. All change brings problems, but whatever the nature of these may be, I am sure that the Corps will triumphantly solve them.

JA Chamier

Air Commodore,
Inspector, Air Training Corps.

Air Commodore J. A. Chamier.

Sergeant Houghton Belton, of Texas, Mr. W. W. Wakefield, M.P., and Private John C. Garret, of Athens, Texas.



Sir Leslie Gossage

by C. G. Grey

AIR MARSHAL SIR LESLIE GOSSAGE, K.C.B., C.V.O., D.S.O., M.C., was a soldier before he became an airman. He had a great deal of active service as a Gunner and as an R.F.C. pilot in the last war. He has served overseas between wars. He has been a diplomat, as our Air Attaché in Berlin. He spent three years before the war in helping to build up Fighter Command, which won the Battle of Britain. He has been Air Member for Personnel in the Air Council.

As a young Gunner officer, when flying was only beginning in 1911-12, he always "wanted to see what was on the other side of the hill," and, like the many other Gunners who were among our earliest aviators, he foresaw what aircraft would mean to the Army. Today he has just the same wish to know what lies ahead, and so he believes in seeing people and their work for himself, and in keeping constantly in touch with his stations and their equipment, rather than sitting in an office and letting reports come to him. I doubt whether there is a balloon station which he has not visited since he took over the Command in December 1940.

Ernest Leslie Gossage was born in Sefton Park, Liverpool, in February 1891. He was at Rugby from 1905 to 1909, and at Trinity College, Cambridge, from 1909 to 1912, when he took his B.A. degree. And while in Trinity he joined the Special Reserve of the Royal Field Artillery, in April 1910

In July 1912 he was gazetted to the R.F.A., and with his battery he went to war in 1914. He was in the retreat from Mons and the advance to the Aisne, and fought in the First Battle of Ypres as a Field Gunner. In 1915 he learnt to fly, and was seconded to the R.F.C.

During the war he collected a Military Cross and a D.S.O. The *Gazette* of March 30th, 1916, says of the M.C.: "For consistently good and zealous work under bad weather conditions, both on patrol and when co-operating with the artillery in operations resulting in the capture of the enemy's positions." There you see the ex-Gunner at work. He was made a Companion of the D.S.O. in 1919 "in recognition of distinguished services rendered during the war." Also, he was mentioned in Army dispatches in January 1916 and in December 1917, and in R.A.F. dispatches in December 1918 and in July 1919.

He continued to serve in the Royal Air Force, and in January 1930 Group Captain Gossage was appointed Air Attaché in Berlin, where, until August 1931, he was able to observe the rise of the National Socialist party and the growth of the German aircraft industry. And few of our people can have understood the Germans better than he did.

Then he was brought back to be Senior Air Staff Officer of the Air Defence of Great Britain, under Air Marshal Sir Geoffrey Salmond, who, himself a Gunner, had helped young Mr. Gossage, R.F.A., to join the R.F.C. in 1915. And in July 1932, while serving in A.D.G.B., he was promoted to Air Commodore.

Air Marshal Sir Leslie Gossage, K.C.B., C.V.O., D.S.O., M.C.

From September 1934 Air Commodore Gossage was Senior Air Staff Officer to Air Vice-Marshal W. S. Mitchell in Iraq. This, I take it, was to acclimatise him to a still hotter climate, for in December 1935 he was made Air Officer Commanding all British Forces in Aden, whilst the Italian campaign in Abyssinia was at its height.

In September 1936 Air Vice-Marshal Gossage (promoted on January 1st of that year) was back in England to command No. 11 (Fighter) Group, which he commanded until February 1940. What No. 11 Group did in winning the Battle of Britain under Air Vice-Marshal Keith Park is history. And how much the Group owed to the officer who had built it up for those years before is evident.

In 1937 Air Vice-Marshal Gossage delivered to the University of London, by invitation of the Board of Military Studies, the series of Royal Air Force Lectures on "Air Power and its Employment," which were published by Wm. Hodge & Co. Although we have learned much by bitter experience since then, these lectures are still a sound base on which to build an education in the use of air power.

In April 1940 Air Vice-Marshal Gossage was appointed Air Member for Personnel on the Air Council, but in December he was pulled out to take command of, and expand, the Balloon Command, which had been left vacant by Air Vice-Marshal Boyd, who had been appointed to Middle-East Command, and was unhappily forced down in Sicily on his way there.

In July 1940 A.V.-M. Gossage was promoted to Temporary Air Marshal, and was promoted K.C.B. in the New Year's Honours of 1941. He had already been created a Companion of the Bath (C.B.) in the Coronation Honours of May 1937 and a Companion of the Victorian Order in July 1937, while he was commanding No. 11 (Fighter) Group.

ABOVE AND BELOW *by* The Editor

The New Chief Commandant

CHANGES in command are customary in the Royal Air Force. They prevent any branch from becoming too dependent on one man and enable a new man to bring new ideas to an old job. The appointment of Air Marshal Sir Leslie Gossage as Chief Commandant and Director-General of the Air Training Corps follows this custom.

The change involves the departure of Air Commodore Chamier and Mr. Wakefield, both of whom will be greatly missed. Air Commodore Chamier, who founded the Corps and saw it through its early troubles, will have the satisfaction of seeing his creation flying by itself. Mr. Wakefield can be sure that the vigour, team-work and skilful direction that he brought to the Corps will be long remembered.

The Corps is so well established that the change is unlikely to cause a violent upheaval in the lives of the cadets, but Air Marshal Gossage will undoubtedly make his influence felt. A man well liked and respected, he has a fine record of service to the Royal Air Force. A Bachelor of Arts at 19, a Lieutenant-Colonel, M.C., at 26, an Air Commodore at 41, a K.C.B. at 49, is a record well worth emulating by any cadet. We wish his every future success.

* * * *

The Mines

THE black shadow of the mines hangs over the heads of thousands of young men who were looking forward to a life of adventure in the Services. The Air Training Corps is less affected than the cadets of the other Services, since those accepted for aircrew are exempt from liability, and of those cadets not physically fit for aircrew a great many will also be physically unfit for the mines. But there are many who fall in between.

In spite of its close association with the Corps, the *Gazette* is an unofficial journal, so it is possible for us to say that the situation with which we are confronted is the result of the past incompetencies of our rulers, who not only failed to prepare the nation for war, but neglected to ensure its prosperity in peace. For years before the war thousands of miners were unemployed and half starving, while thousands got jobs in other trades. Those still at work toiled for pittances. It was argued that the industry could not stand better wages.

It may be argued that it was all a matter of private enterprise, and therefore not the affair of the Government. But we see to-day that the shortage of coal is threatening the national safety. Anything that threatens the national safety is a national affair. But before we lay all the blame on the politicians, let us remember that the public gets the Government it deserves, and the public before the war were certainly apathetic in matters of national interest.

To-day the Government, under the spur of war, has to do something, so you have to carry the can. To employ the idle inmates of our prisons would be unfair to the miners. To employ Italian prisoners-of-war is contrary to the usages of war. To employ black marketeers would ruin a lot of big businesses.

One would think that after three years of conscription and direction of labour there would be thousands of misfits in the Army and in industry who would volunteer for the mines if given the opportunity of doing so. But the Government has decided against that, and has picked on the eighteen-year-olds.

Assuming that is the best solution, what about exempting members of the A.T.C., J.T.C., Sea Cadets and Army Cadets who are able to show a good record of attendances? That would mean that practically every public-school boy would be exempt, at no great inconvenience, since membership of the A.T.C. or J.T.C. is at most public schools almost a matter of routine. Such a preponderance of upper-class exemptions would hardly be fair. It would be unfair also to the young men who, because of night-work or overtime, have been unable to join a cadet corps. And, after all, as membership of the A.T.C. and attendance at its parades (not always the same thing) is no hardship it would be too easy a price to pay for exemption from a liability imposed on others who have not had that privilege.

It would be equally unfair if the Government selected only those young men who, because of their schooling, had never done any work.

The whole business is most unfortunate, but no one who is sent down the mines need feel that his A.T.C. training has been wasted. It will always be a pleasant memory and a valuable part of his education. Nor should he feel that he has been double-crossed. The Air Ministry never *guaranteed* that A.T.C. Cadets should have the right to enter the Royal Air Force. All it offered was "preference." To have given the right would have meant handing over R.A.F. recruiting from the Royal Air Force to the A.T.C., and the Air Ministry is too wide-awake to do that.

Those selected for the mines will find themselves among people who, in spite of all the disadvantages under which they have been born and bred, are decent, cleanly and often very well educated. And they will be doing their duty and helping to win the war as much as anyone else.

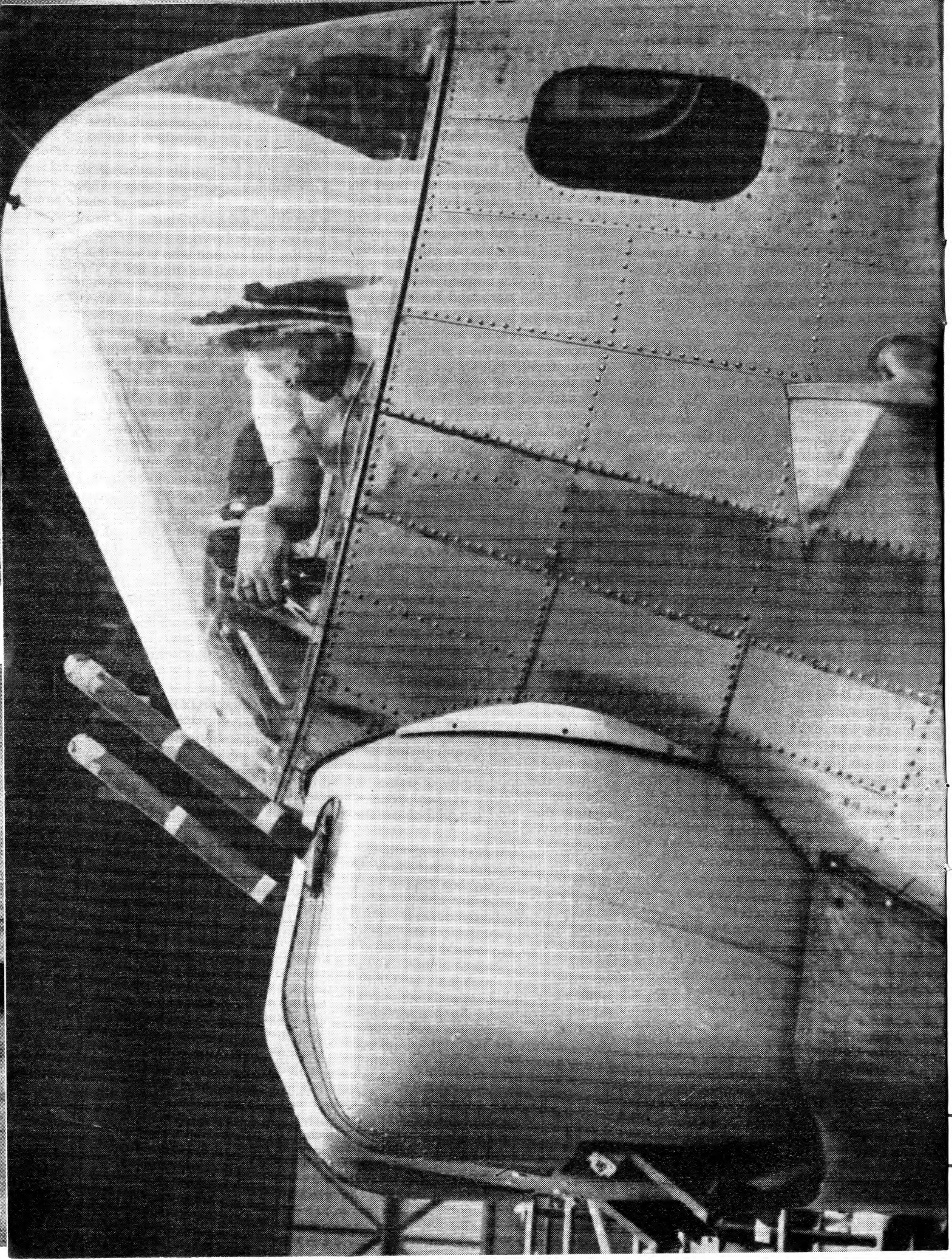
* * * *

The Future

SIR ARCHIBALD SINCLAIR, Secretary of State for Air, stated, when he opened an exhibition under the title "A.T.C. Calling," in London, that if the flying services were to be provided with young men, healthy and worthy of that great vocation, it was clear that the corps would be needed after the war.

"The long-term nature of A.T.C. training demands that the future of the corps shall be settled now," he continued. "The achievements of the A.T.C. in war, and circumstances likely to exist when hostilities end, have been reviewed, and the Government have decided that the Air Training Corps shall continue after the war. It should co-operate to the fullest extent with other pre-Service training corps, departments of education, local education authorities and other voluntary youth organisations; but the separate identity of the A.T.C. under the control of the Air Ministry will be preserved."

"A.T.C. Calling" depicts the training provided by the Corps, from the early stages through the advanced technical and aircrew instruction, to the final qualification for entry into the R.A.F. or Fleet Air Arm.



The nose of a Fortress B-17G fitted with a remotely-controlled power-operated "chin-turret," which house two .5 in. machine guns.

CAPT. NORMAN MACMILLAN, M.C. A.F.C. on

Performance TESTING

AFTER the handling trials are over and the flying characteristics of the aircraft are known to be as good as they can be made, it is essential for the prototype test pilot to establish the performance of every new aircraft.

Let us see just where the test pilot has to begin.

Whenever an aeroplane is designed an estimate of performance is made by the design staff. The tabulated data includes the climb curves and ceilings under various alternatives of load, the speeds developed at certain heights, the stalling speeds with and without flaps, and the duration of flight under various conditions. The test pilot has to provide the proof check upon the calculations, and thereby show how nearly the aircraft fulfils its designer's expectations.

The performance estimate is calculated to occur in what is called a standard atmosphere. We all know that the air conditions change from day to day, often from hour to hour. Some means of levelling out all these changes in the atmosphere are essential if aeroplanes are to be compared one with another in flight. The standard atmosphere is a kind of common denominator used for the purpose of making the comparisons. It may occasionally exist in nature, but more often it does not. The test pilot must therefore take readings of the atmosphere in which he flies, so that the actual atmosphere can be converted into the standard atmosphere and the recorded performance of the aircraft adjusted in relation to this basic atmosphere wherein all aircraft designers picture their aircraft to fly.

At the time of the test flight the barometer reading and the height of the aerodrome must be noted, and, as the aeroplane climbs, the air temperature must be recorded at regular intervals. Sometimes temperature inversions are found when, as the aeroplane climbs over perhaps some four thousand feet, the air temperature rises or remains steady instead of falling in the normal way. All these variations are transposed into the standard atmosphere, and the air speeds and rates of climb of the aircraft are adjusted accordingly.

The climb performance and the level speeds are tested at the maximum permissible continuous power output of the engine (or engines).

When the maximum permissible power of an engine is governed by the boost pressure in the induction system it is necessary for the test pilot to be continually alert to see that the required boost is accurately maintained.

With a normally aspirated engine such as is found in most light aircraft used for elementary training, the test pilot opens the throttle fully for the take-off and keeps it full open throughout the climb. The engine revolutions fall as the aircraft rises into thinner air because the constantly falling atmospheric pressure continually increases the negative pressure in the induction system, thus requiring a reduction in the amount of petrol fed into the engine, and so causing a drop in power.

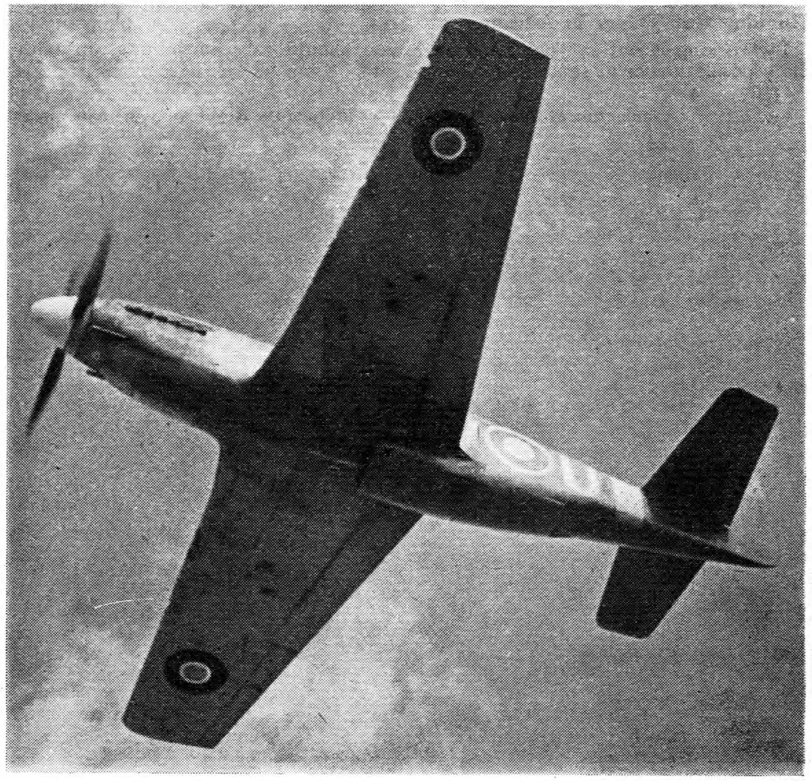
With an engine of the supercharged type the test pilot must steadily open the throttle as he climbs to maintain the maximum permissible boost in the induction system. When possible, engine revolutions are maintained at the maximum speed permissible for continuous running. The advantage of the constant-speed airscrew is obvious, for by no other means can the desired combination of maximum permissible engine speed and maximum permissible boost be obtained and maintained throughout the climb to full-throttle height. From full-throttle height upward the supercharged engine behaves in the same way as a normally aspirated engine, with its power decreasing as the climb continues.

When testing for climb the pilot must fly the aircraft at its maximum rate-of-climb attitude. The rate-of-climb indicator provides a useful guide to the attitude required, but it is desirable to make a check by a series of "saw-tooth" climbs at different heights, timing each by stop-watch. A rate-of-climb curve can then be drawn and the exact air speeds for fastest climb established.

In a fast-climbing aircraft every aid that can be given to the test pilot is valuable, especially to the test pilot of single-seat aircraft who has to do everything for himself, without second pilot or flight engineer or research technician to help him. In the larger aircraft the test pilot can concentrate on the flying and leave the collection of data to others. Two ways of aiding the work are by the use of automatic recording instruments and by repeater photographs of the test instrument panel; both methods provide a permanent record, and a check on handwritten notes.

When the climb is completed, level speed at full throttle is taken at service ceiling. On the way down a series of full-speed level runs is made at different heights. The figures derived from these tests, together with fuel consumption tests at different speeds and heights and the speed of stall, provide the designer with the principal data he requires to check his performance estimate, and prepare a guaranteed performance table for his latest aircraft.

A North American Mustang of the Tactical Air Force. The latest version of this aircraft is fitted with two 500-lb. bombs, one under each wing, and is known as the Invader.



Formation Flying

BY LIEUTENANT COMMANDER (A)

LIKE all things in which speed of action is the first consideration—whether it be a game of soccer, or a dogfight with half a dozen Axis "partners" at 25,000 feet—some careful thinking beforehand is worth all the skill you can put into formation flying.

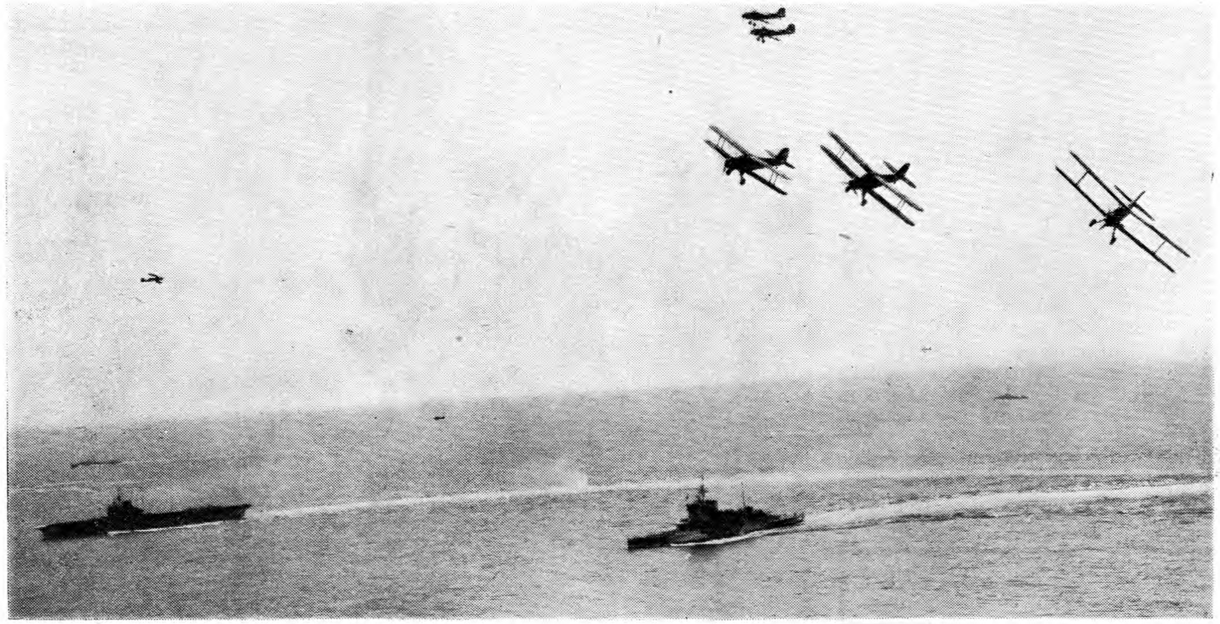
Sometimes in the air, when you have a hundred other matters to attend to, the temptation is to do the obvious thing; but that obvious thing is not necessarily the right thing. And it is vitally important to you, and to everyone else concerned, that you should do the right thing.

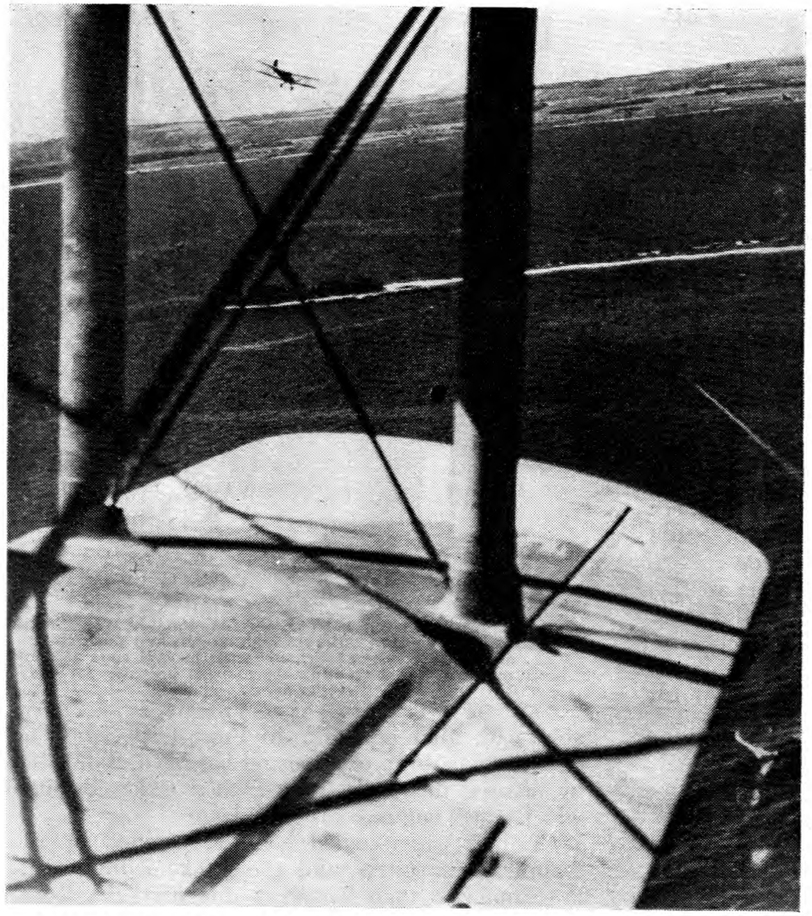
Thinking Out Things in Advance

By working it out in your mind on the ground, now or at some time when you can concentrate on it without being interrupted, you will sort out the obvious things from the right things. Let us take one good example: Suppose you are number three of a section of three fighters. Your orders are to "scramble" and join up with your section leader at 1,500 feet over base. Now, your section leader's job is to get his section together in the shortest possible time (and seconds, in air warfare, are the same value as hours to the high-pressure business executive), and to start his operational climb, low-level interception, or patrol immediately. He's going to be more upset than somewhat with you if, as number three, you take longer than he thinks you should take in joining up with him. Conversely, he's going to be pretty set up with you if you get there before he expected to see you.

In this case we'll assume that you are fully operational, and that you're in a certain escort carrier at sea. Your section leader is parked on the deck ahead of you, with number two just behind him. All three of you are warming up your engines. As the ship comes round into wind, Commander Flying on the bridge gives the "O.K.", and the "batting" officer lets your leader off. As he goes down the deck, and number two is opening his throttle and shaking your own Seafire with his slipstream, you are saying to yourself: "I'm going to do the smoothest and fastest join-up anyone has ever seen." Meanwhile number two is off the deck. And then it's your turn.

A formation of Albacores flying over units of the Royal Navy, with an aircraft carrier in the left foreground.





Training tin-fish pilots. The target ship can be seen through the wing struts and on the right the tracks of the dummy torpedoes.

Catching Up with the Leader

Once in the air you get your wheels up, close your hood, and settle down to the main job—where's that section leader? "Ah," you say, "there he is: now to catch him." He will be turning in a wide circle, if he knows his job, with the carrier as its centre, and he's going to go on turning in that circle until he's got the section together. Number two is close behind him and quickly closing up. Both of them are a mile or so away from you.

This is where your thinking beforehand is going to decide between your doing the obvious thing and the right thing. The natural temptation is to set a direct course for the leader, open the throttle wide, and catch him up. Hundreds of experienced pilots make this mistake, and go on making it. A little calculation on the ground, which you probably won't have time for in the air, would tell you that, full throttle or not, your leader's speed is higher than your own and is going up all the time—he's been off the deck just that much longer and has had that much more time to build up his airspeed. So it isn't any good "flogging" your Merlin engine and vainly hoping that by following the same track through the sky as your leader (who's going faster than you anyway, to begin with) you'll eventually catch him up. Perhaps you will catch him up sometime, but to say that he'll be tired of waiting for you, and that you've let the side down, would be putting it mildly.

Don't Chase Him

If you've been doing that proper thinking beforehand you'll know the right answer at once. You won't make the mistake of chasing after that leader, but you'll remember that by the time you get across the circle he will be a third of the way round it himself. So instead of flying directly towards where the leader is at the moment you start out after him, you choose a point in the sky on the line of the great circle which he is flying round, where you think he will be by the time you, having cut straight across the circle, can get there yourself.

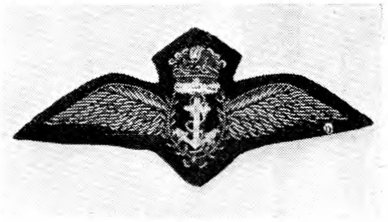
Short-Cut

Having chosen that point, you stick to it and fly straight there. If your guess has been anywhere near right you'll arrive there at the same time as your leader, and then all you have to do is slip in your place on his port side. If your guess has been a bad one you won't in any case be far out, and it will be short work to join him. Whichever way it happens, when you do close up on him you'll be rewarded with a smile and a gratified "thumbs up," and you'll know that you haven't kept the section from starting its allotted job for one unnecessary second.

That is just one example of why a flight mustn't begin only when you take off: it must begin in your head before you even get into the cockpit; and your clear thinking beforehand must forewarn you against the temptation of doing that obvious thing, and prepare you for doing the right thing. Sometimes, of course, "obvious" and "right" are one and the same thing; but, more often than not, circumstances will be misleading, and, as pitfalls, can only be avoided if clearly foreseen. And don't imagine that all this thinking must be left until you've started your flying. Now is the time to do it.

FLEET AIR ARM AIRCREW BREVETS

Observer.



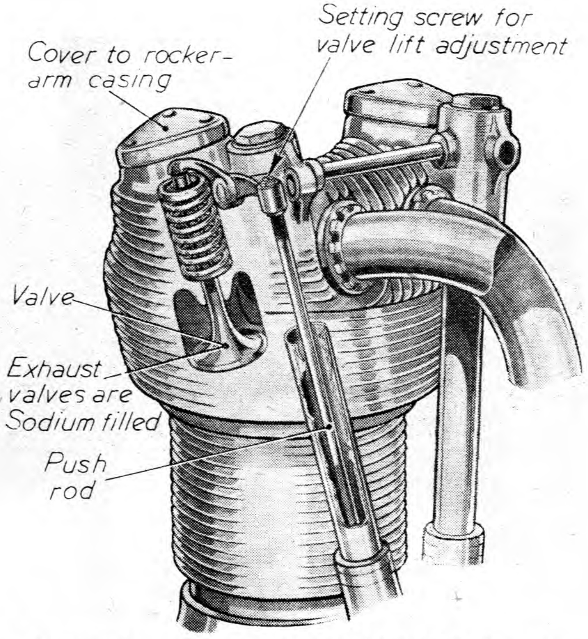
Pilot.

Air Gunner.

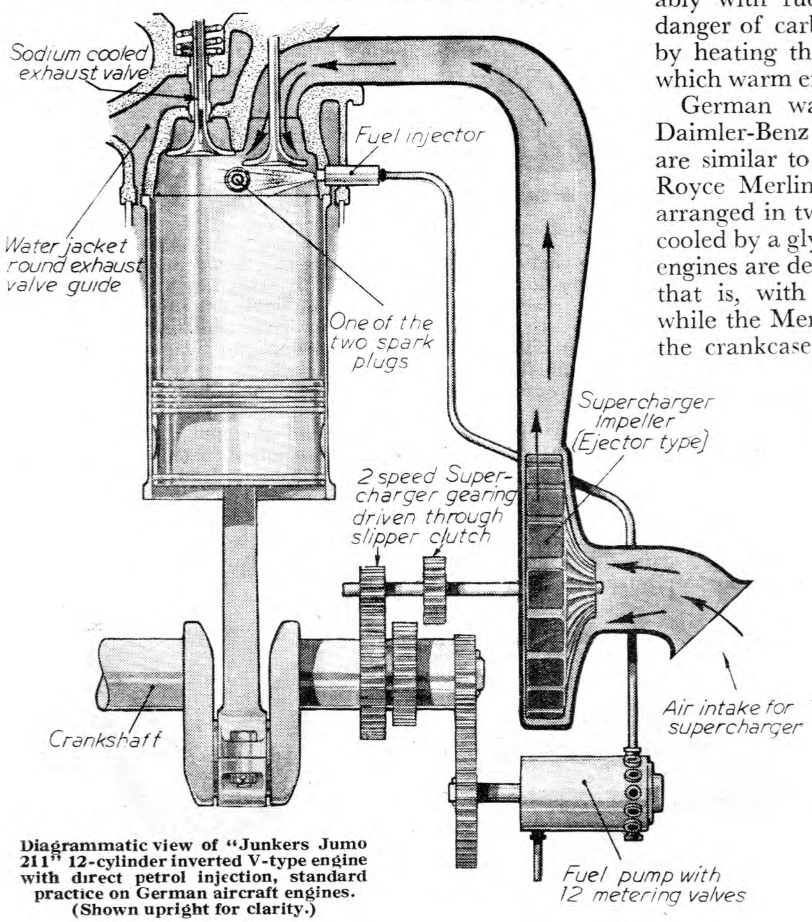
Engine Comparisons

It is interesting to compare the qualities of the engines which propel the Luftwaffe aircraft with those of our own, for although we now hold air superiority in all spheres, German engines are excellent pieces of machinery with some ingenious technical features.

The outstanding difference between British and German engines is in the feeding of the fuel to the cylinders. All German engines now employ direct injection of the liquid fuel into the cylinders, whereas in all British engines the fuel is mixed with air in a carburettor and then passed to the cylinders. The former method has the advantages of better fuel consumption, and allows lower-grade fuel to be used, due to the good turbulence of the air-fuel mixture in the cylinder. It also has the advantage that the danger of ice formation which occurs in the choke tube of a carburettor is eliminated. However, carburettors have been highly developed in this country, so that they compare very favourably with fuel injection in most respects. The danger of carburettor freezing has been eliminated by heating the choke tube with a jacket through which warm engine oil is passed.



The normal poppet-type valves are used in the B.M.W. engine, actuated by drum-type cams through tappets and push rods. The tappets are pressure lubricated and the ball ends of the push rods are bored to allow oil to pass up them for the rocker arms.



Diagrammatic view of "Junkers Jumo 211" 12-cylinder inverted V-type engine with direct petrol injection, standard practice on German aircraft engines. (Shown upright for clarity.)

German water-cooled engines, typified by the Daimler-Benz 601N and the Junkers Jumo 211, are similar to their British counterpart, the Rolls-Royce Merlin, in that they have twelve cylinders arranged in two banks of six, forming a V, and are cooled by a glycol-water mixture. The two German engines are designed to run in the inverted position, that is, with the cylinders under the crankcase, while the Merlin operates with the cylinders above the crankcase. Both German engines revolve at a slower speed, and therefore produce less power per unit of swept cylinder volume than the Merlin. For instance, the D.B. 601 produces 1,200 h.p. at 2,600 r.p.m. at take-off for a swept volume of 33·9 litres, whereas the Merlin XX produces 1,280 h.p. at 3,000 r.p.m. for only 27 litres. These two engines deal with the problem of supercharging in rather different ways, the D.B. 601 having a fluid drive to the supercharger similar to that used on some motor-cars. This allows the supercharger to be turned relatively slowly at ground-level, where the air is dense, so that the engine is supplied with all the air it wants to produce its maximum power. As height is gained the supercharger is driven progressively faster in order to supply the engine with the necessary amount of air to maintain its power output in the rarer atmosphere. This increase of supercharger speed continues until a height is reached where the fluid no longer allows any slip between the engine crankshaft and the supercharger rotor. Any increase of altitude beyond this results in decrease in engine power. The Merlin XX has direct drive to its supercharger incorporating a two-speed gear, so that when the altitude is reached when the lower gear ratio no longer drives the supercharger fast enough to maintain full power, the high gear is engaged, which allows the engine to maintain power for a further increase of altitude. At ground-level the throttle has to be partly closed, otherwise the engine would be supplied with more air, and hence supply more power than it could stand without overheating and mechanical failure. The throttle is automatically opened progressively until the optimum altitude for the low gear is reached where the throttle is fully open. Then when high gear is engaged the throttle is partially closed again, for the same reason, until the second optimum height is reached, beyond which the engine power decreases with altitude. This system is not so good as that used on the D.B. 601, as power is wasted in driving the supercharger faster than is required at low altitude. Both engines have a cut-out device which allows extra high boost for the short take-off period.

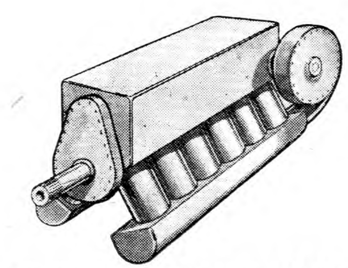
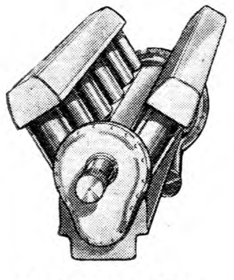
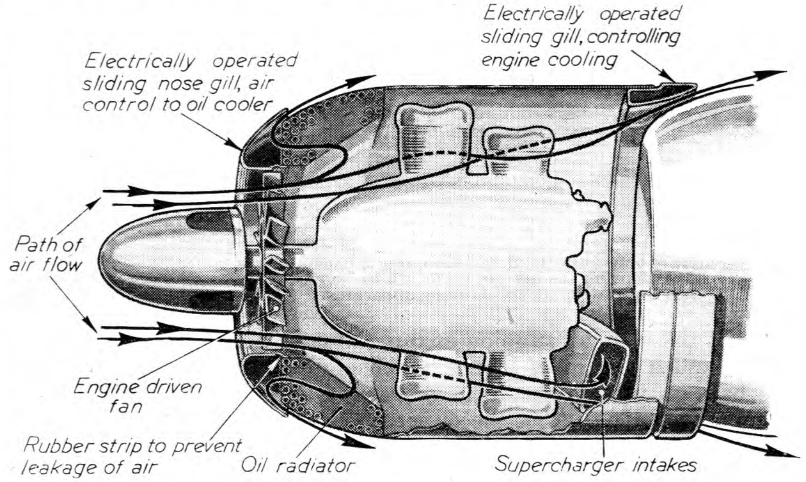


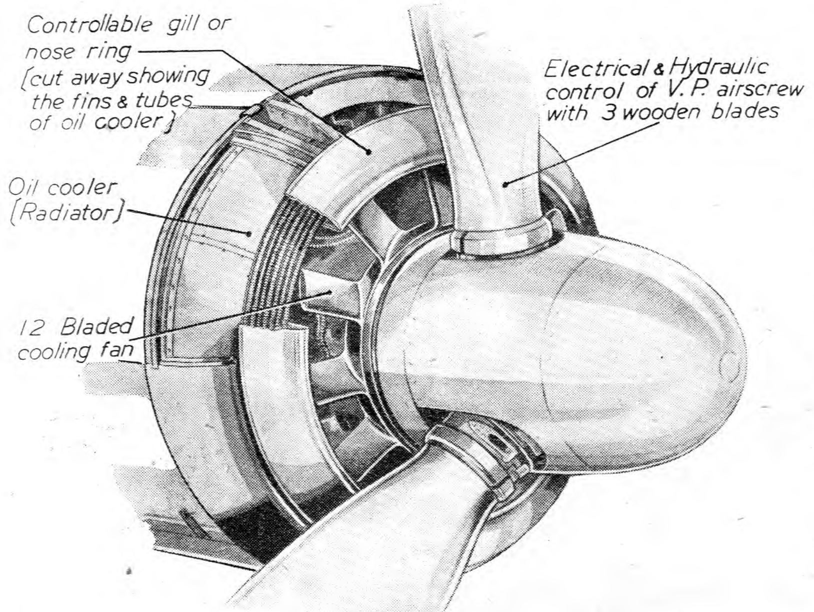
Diagram showing the inverted V German engine with supercharger at the side, allowing cannon gun to fire through airscrew hub by being positioned between the two cylinder banks.



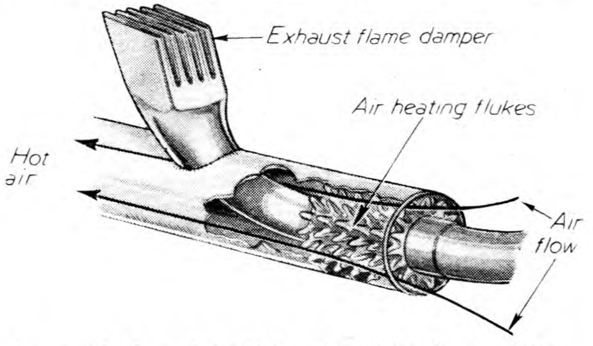
A British engine with usual upright V.



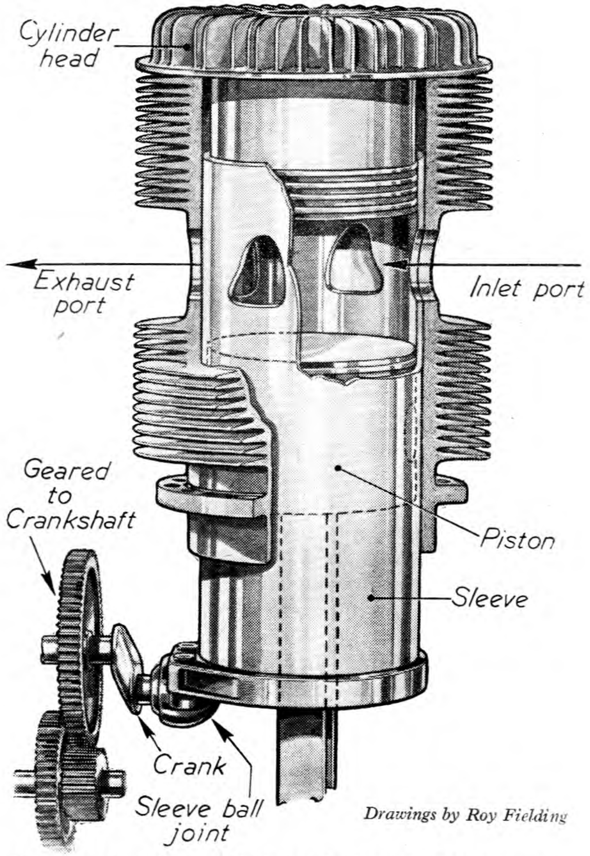
View of the B.M.W. 801A showing airscrew and oil cooling arrangements with sliding gill or nose ring.



Comparing air-cooled engines, there is little to choose between the 1,400-h.p. Bristol Hercules and the 1,580-h.p. B.M.W. 801, the Hercules being the slightly smaller. They are both 14-cylinder engines with the cylinders arranged in two banks of seven, the Hercules being fed through a carburettor and the B.M.W. having direct fuel injection. They both have two-speed superchargers. The major difference lies in the valve gear, the Hercules having sleeve valves and the B.M.W. having conventional poppet valves. The sleeve-valve system has several important advantages over the poppet-valve system. Most important is the simplicity and the small number of component parts. Maintenance is greatly simplified, the top overhaul, which is so necessary on the poppet-valve engine, being almost completely eliminated. Also, the improved cylinder-head shape, made possible by the absence of valves, allows a higher compression ratio to be used, resulting in improved fuel consumption. The B.M.W. is really designed as a complete power plant for use in the Focke Wulf 190 and the Dornier 217. As such it forms one of the most cleverly streamlined air-cooled units ever designed. The cooling is helped by an engine-driven fan in front of the cylinder running at three times engine speed, and a system of baffles which ensures that the back as well as the front of each cylinder is adequately cooled. Also, the outlet for the cooling air is through an annular slot, the width of which is varied by a sliding ring. This is an improvement on the gills used on Bristol power plants, which open outwards into the slipstream, causing unnecessary drag. Another feature of this engine is a single-lever control for engine speed, boost-pressure, ignition timing and supercharger speed.



An example of one of the 14-flame damping exhausts of the B.M.W. 801A showing the hot air muffs which supply cabin heating and hot air for de-icing apparatus.



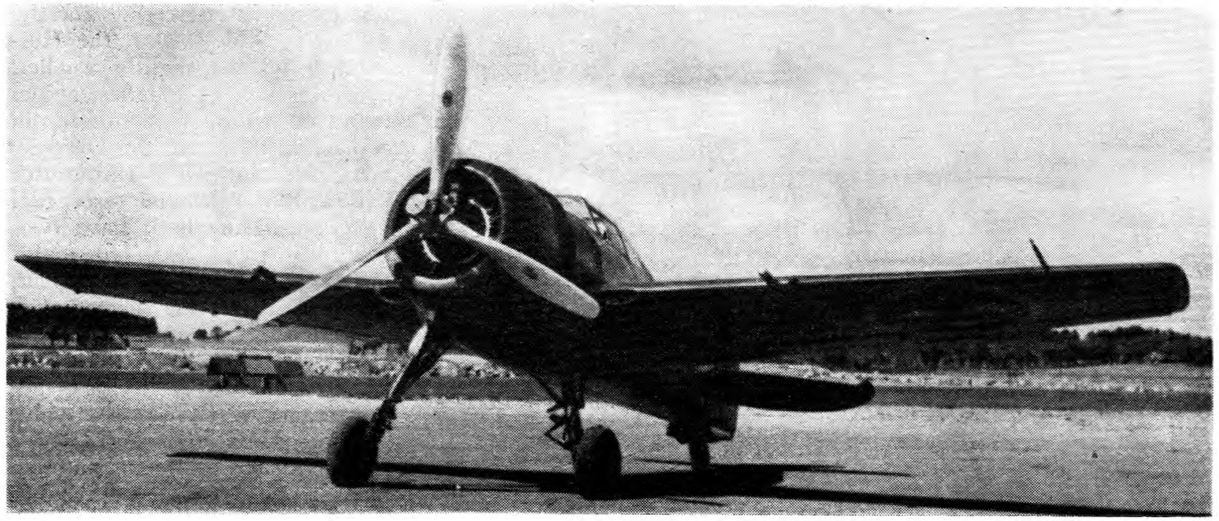
Drawings by Roy Fielding

The sleeve describes an eliptical path of travel as it is operated by a crank as shown driven through gears from crankshaft so causing the ports in the sleeve to register with those in the cylinder castings.

Approximately contemporary engines have been used as a basis of this comparison, but the latest British engines such as the 24-cylinder Napier Sabre and the latest marks of Merlin, are a great improvement on earlier types, and definitely have not been matched by any equivalent improvements in German engines.

R. J. Packman.

A fighter of the Swedish Air Force, the J.22. This single-seat fighter is of Swedish design and is believed to be powered by a Pratt and Whitney Twin-Wasp engine driving a Hamilton Standard three-bladed airscrew. Span 32 ft. 10 ins., overall length 25 ft. 6 in.



Balance of Flight

by Astro

LIKE a finely wrought sword the modern bomber must be perfectly balanced as it sweeps through the air towards its target. Every modern bomber is as delicately balanced as Excalabar itself. One of the finest of them all is the Avro Lancaster.

In flight this aircraft has perfect balance in all directions. The point at which the aeroplane is balanced is called its Centre of Gravity, abbreviated C of G. This is not actually a fixed point, as it varies according to the distribution of the loaded weight. But a point is fixed on the aeroplane called the C of G datum, from which all load distribution is calculated. Naturally, if the load is too far aft of this datum the aircraft will be tail-heavy. To prevent this occurring, tables are prepared called loading data, and when the bomber is loaded these tables lay down the position of bombs and the filling of many fuel tanks. This last is very important, because as the fuel is used up the balance ("trim") would be seriously affected unless the tanks were emptied in the correct order laid down for the type. This is the flight engineer's responsibility on a big four-engined aircraft. To ensure that the fuel and bombs are expended without seriously affecting the trim of any bomber the loading data must be strictly adhered to both for fuel and bombs. This guarantees a correct distribution and expenditure of the fuel-bomb load, so that for take-off and landing the aircraft is perfectly balanced. A moment's consideration will show what a feat of skill this loading business is.

To illustrate how balance can be affected: when the undercarriage is retracted on the Lancaster the centre of gravity moves back *two feet.* When it is realised that the undercarriage weighs only a fraction of the fuel-bomb load the need for careful distribution of this load is obvious. One hears of the biggest bomber almost leaping up as the bombs leave the racks. Imagine what would happen if the trim were seriously upset at that moment! The aircraft would be uncontrollable.

The aircrew can also seriously affect balance if they move about without due care. So at take-off and landing the aircrew are allotted stations from which they do not move until the aircraft is either full airborne or land-borne. This is just an additional safety precaution, and is not irksome because the crews are allowed quite a degree of freedom of movement during flight. Naturally, those nearest the centre of gravity have the most freedom, while the rear gunner must inform the pilot if he is going to leave the rear turret, so that the pilot can then adjust his trimming-tabs to allow for the more drastic change of trim. The movement around the C of G for any member of the aircrew is calculated, and can be corrected for if the pilot is warned.

Let us assume a loaded weight of 55,000 lb. At take-off about a third of this is consumable load, say 8,000 lb. of bombs and 14,000 lb. of fuel. When the aircraft lands it will be more than 20,000 lb. lighter. The C of G limit for the loaded weight of 55,000 lb. is about 5 ft. 6 in. behind the C of G datum. This means very careful loading before take-off, so that the disposable load will be properly arranged about this datum, not only for take-off but after the bombs have been dropped and almost all the fuel used up.

To facilitate loading, bombs are arranged in categories. These categories are determined chiefly by the distance the bomber is to fly. For instance, for the journey to Peenemunde, the bomb category would be lighter than for a nearer target, owing to the smaller quantity of fuel needed for the shorter trip. So the closer we can get to Germany the bigger the bomb categories we can use. This means that less bombers will be needed to carry the same loads as now, so allowing a greater number of targets to be plastered at the same time. This would mean scattered defences and smaller losses. But however the ratio of fuel-bomb load is arranged, the balance of the aircraft must be the first consideration when loading for any target.

Loading up a case of incendiaries alongside a blockbuster on a Lancaster.

'STRINGBAG' says Steer clear of the Standing wave

ON March 21st, 1941, I was flying down the east side of the Grampians between the mountains and a line which joins the towns of Edzell and Kirriemuir. It was an extremely rough day, so that even my old Shark, which weighed nearly five tons, was behaving like a steer at a rodeo.

Then, without warning, I flew into smooth air and suddenly began to climb at more than one thousand feet a minute. I went up from three to eight thousand feet just as though the throttle was wide open and the aircraft in a climbing position. On the way a bar of cloud which was slowly revolving like the shaft of some giant piece of machinery was passed. At eight thousand feet the altimeter settled down, and we flew on with a superb view of billowing cloud-tops stretching over the mountains to the horizon.

What had happened was that a 35-knot wind from the north-west had swept across the high ground, cataracted down its sides and risen again in a standing wave, such as is seen in a current of water on the downstream side of a submerged rock. I had flown into the upper half of the wave, passed the lenticular cloud which had formed on its crest as it turned over, and had then been carried above it through the air, which had bent to conform to the shape of the wave below.

This phenomenon is the most sensational of all which is used by expert glider pilots.

On June 23rd, 1939, a sailplane was launched from the foot of the Hartside ridge, which falls 1,500 feet from the shoulders of Cross Fell, and picked up just such a wave. The pilot experienced wild airs on the first thousand feet of his climb. After that the wave smoothed out and accelerated him to nine thousand feet at a rate of climb which was probably in excess of 40 feet a second. A few minutes later the British height record was broken at 11,140 feet.

In due course the pilot tried to descend, but he found that the upcurrent was so strong that he failed to lose height even in a spin. Had he taken to his parachute he would have been carried up rather than down. Finally he battled his way upwind and came down over the mountain, to be finally cataracted to earth in a sensational descent over the lip of the ridge in the down-current which fed the wave.

The moral to be drawn by all pilots, except soaring enthusiasts, is to steer clear of a standing wave. While it is a comparative rarity and can only be caused through a combination of the ground contours and a high wind from a particular direction, it has been the cause of numerous disasters. The wave can always be recognised by a lenticular bar standing out on the lee-side of high ground and stretching for several miles parallel with the ridge.

Those who reach the advanced soaring stage are much more likely to make use of the thermal currents which I have already described and in particular the conditions known as a "cold front."

"A cold front" was soared for the first time in England only in 1931, but since then it has become the vehicle for many cross-country flights. It has a particular significance for the Service pilot as well.

In principle it consists of a mass of cold air which moves across the country, cutting beneath the warm air ahead of it, and, like a snow-plough, shovelling the latter over the top. You meet it particularly in the spring, when driving storms, trailing curtains of hail, sweep across the country, to be followed almost immediately by another brief period of sunshine. The glider pilot can see the storm sweeping down on him while he beats up and down his soaring ridge. The air may begin to grow turbulent when the storm is within about a mile, and just as the black edge of the "front" envelopes him he may find up-currents of over 20 feet a second. This will take him up the face of the storm to three or four thousand feet, and from here he can ride ahead of it in clear but turbulent air until the storm blows itself out. If the massive cloud itself is entered, icing is more than probable. A pilot inside such a storm tells how his perspex windscreen became frosted up and he found himself blind-flying in the fullest sense of the word. At four thousand feet it was snowing inside the cloud so heavily that the sheer weight of the snow became a menace and he decided to get out. After several minutes' flying on a straight and level course there was still no visibility of any kind. It then occurred to him to rub the windscreen with his handkerchief, when he discovered that he was already flying in brilliant sunshine with the cloud behind him. This flying incident occurred in a miniature "front" from which escape was simple. The massive wall of cloud stretching from horizon to horizon is a different thing. While it is a fine vehicle for glider pilots, it is probably healthier for power pilots to land and wait until it has gone over. It will probably reach up to more than ten thousand feet, and unless there is good reason to believe that the sky at the back of it is clear, an eventual descent may have to be made through a ten-tenths overcast.

It should not be supposed that all the storms of this kind are necessarily "cold fronts." Many of them will be "occluded fronts"—that is to say, a mass of cold air which has been pursued and caught up by a mass of warm air, probably bringing rain, but not the strong up-draughts associated with the former.

The cumulus nimbus, with its castellated turrets and snow battlements, will have degenerated into soft grey clouds spread over the whole horizon. There will have been a complete collapse of the front's former glories, and the overcast will be as useless to gliders as—with its poor visibility—it may also be to Service pilots.

In the course of these articles I have explained the two principal sets of conditions upon which experienced soaring pilots base their calculations. First are the convection currents set up by the uneven heating of the ground, materialising in the cumulus clouds of a summer day, and the second depending on the movements of air masses, such as "fronts" which I have just described. There is just one other type of current which I have frequently used in a sailplane. It is to be found on the underside of almost any cumulus which has a big vertical development. Such a cloud probably had its birth in a thermal bubble. It grew and expanded as other thermals were added to it. By midday it may perhaps be three or four thousand feet deep and measure a mile across its base. Such a cloud will itself cast a big shadow. Beneath it the air will be inclined to cool, so that the sun-warmed atmosphere about its sides will tend to seep into the base and be drawn up inside it.

My own experience makes me believe that this particular effect extends to quite a thousand feet beneath its base. I have at any rate circled up into a sort of concave bell in the base of the cloud in just such a current. If therefore a glider pilot can place himself beneath a cumulus during the heat of the day it is more than likely that he can win more height.

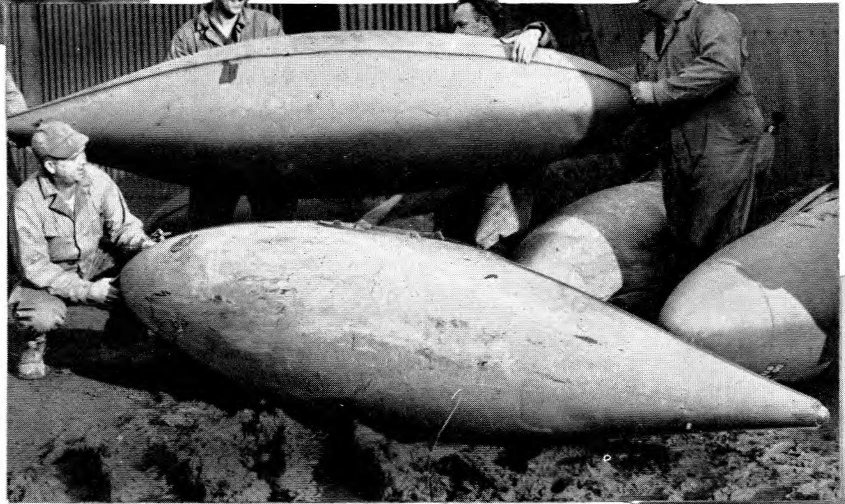
In conclusion, it should be said that even the experts have still a great deal to learn about the secrets of the air currents. Flyers have already made a great contribution to meteorology, both in confounding some theories and in supporting others.

The Flying DUTCHMAN

The late Commander E. Bakker, 34-year-old leader of a squadron of the Royal Dutch Naval Air Service, attached to the R.A.F. Coastal Command, flying Mitchells. In the picture in the bottom left hand corner, Commander Bakker briefs his crews.

A Hawker Typhoon IB

Auxiliary FUEL TANKS



Teamed with Thunderbolts, Lockheed Lightnings are now escorting Fortresses & Liberators deeper into Germany on daylight precision raids, thanks to the addition of auxiliary fuel tanks which greatly improve the Lightning's operational range.

Flying Control

by COLIN GORDON

IN days gone by when squadrons were small and concrete runways almost unheard of a pilot was free to take off and land at his own free will. But with the advent of runways and greatly enlarged and busier airfields some form of traffic control became necessary. Hence the present-day branch of the Royal Air Force known as Flying Control.

Flying Control is, in reality, the old-time Duty Pilot grown out of all recognition. It has become a massive organisation, the centre of which is at the Air Ministry and which radiates to every airfield in Great Britain and those countries from which British and Allied aircraft are now operating. Working in close co-operation with the Signals and Meteorological sections, it maintains a ceaseless 24-hour watch from one end of the year to the other, and, whilst it may have many subsidiary functions, it is primarily intended to ensure the greatest safety of aircraft and to afford them the utmost possible assistance, whether they be in distress or not.

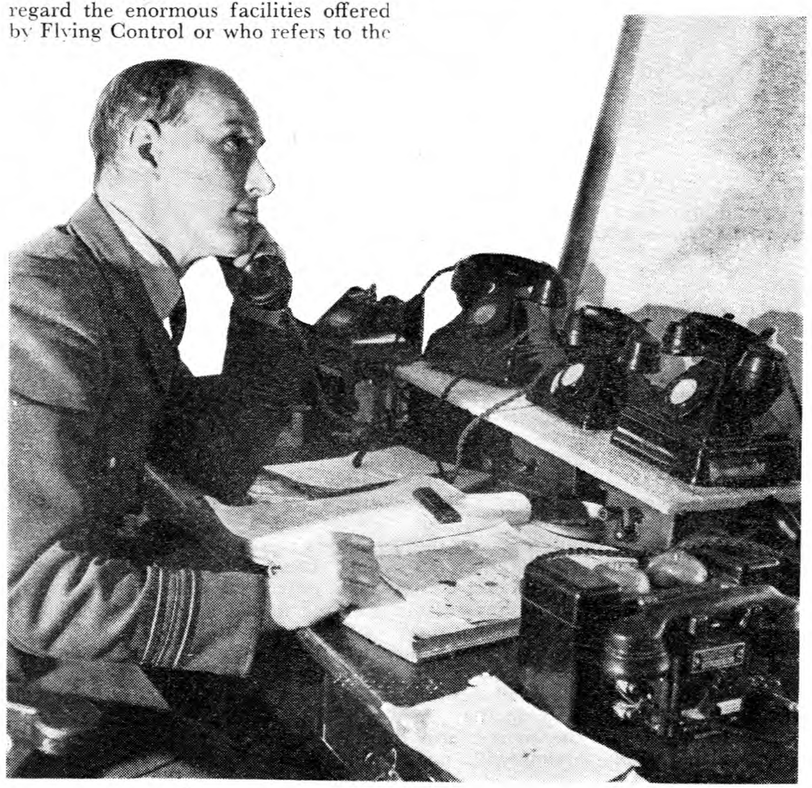
Its personnel are all highly trained men, some of whom may be ex-aircrew and now grounded. Others may be direct entries, but because of this do not regard them as "wingless wonders." They have undergone an intensive course embracing signals, navigation, meteorology and general flying-control procedure. They have also flown a specified number of hours, both by day and by night, during which time they are required to take the part of navigator and wireless operator and assume complete responsibility for guiding the pilot over a two- or three-hundred-mile course. This latter is important in order to give those with no previous flying experience a picture of Flying Control from the aircrew's point of view and help them to appreciate their own work from every possible angle.

The life of an F.C.O. (Flying Control Officer) is often unenviable, for it carries with it enormous responsibilities. Much of his work is purely routine, but there are times when he may be forced to make lightning decisions in the face of heavy odds. He may have as many as twenty aircraft returning from a raid simultaneously. Of these, L for London may have been damaged by enemy action, its crew injured and therefore in urgent need of medical assistance; P for Peter may have engine trouble causing loss of height and the necessity for an immediate landing, while T for Tommy may be short of fuel and also requesting a priority landing. All this may be taking place in the dark and in weather conditions so bad that only "controlled descents through cloud" are possible. The F.C.O. has to decide immediately which aircraft he should land first. He must then carry out the controlled-approach procedure, remaining calm throughout, although people around him may be flapping and his numerous telephones never stop ringing. Throughout all this his mind is tortured by the knowledge that he has other aircraft in distress but about which he can do nothing until the one he is controlling has landed. In addition, the cloud base may be lowering, and he knows that he has a race with time to get all his aircraft in before the airfield goes "unfit."

No. The F.C.O.'s is not an enviable task, and anyone who tends to disregard the enormous facilities offered by Flying Control or who refers to the F.C.O. as a "wingless wonder" will certainly live to regret it. He is a man to be respected. He is a man whose sole purpose is to help aircrews in every possible way, and not, as a few misguided people think, to obstruct them with red tape. Moreover, it is a proved certainty that if a pilot and his crew co-operate with Flying Control, then only good can come of it.

In conclusion, the following advice to cadets who are about to become aircrew may prove helpful. It is the advice born of experience both as a pilot and, later, as an F.C.O.

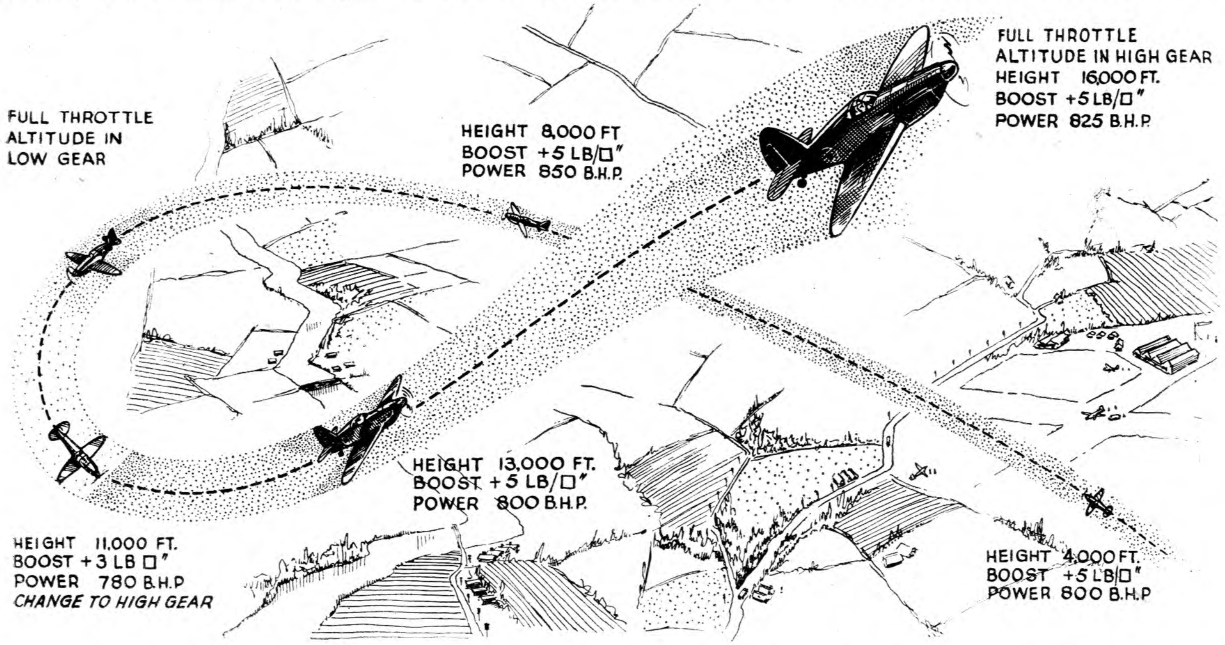
When you have been posted to a new station, visit Flying Control as soon as possible. Acquaint yourself thoroughly with local flying regulations, airfield layout, local landmarks, weather peculiarities in that district, and, in general, all the facilities available from Flying Control at that station. Make sure that you know the local night-flying procedure and airfield lighting at that airfield. However well you know an airfield and its runways by day, it presents a totally different aspect by night. Get to know your F.C.O.s. The more you talk to them in the mess or elsewhere the more confidence you will have in their ability to help you out of an emergency in the air if and when the occasion arises. The latter is important, because it helps to build that co-operation between crews and Flying Control which is so essential and which may well prove to be the cause of your salvation one day.



Two-speed Superchargers

by J. A. Kyd

THE purpose of the aero-engine supercharger is to raise the pressure of the combustible mixture before it enters the cylinders, thus ensuring a more potent explosion to push the pistons down the cylinders, with the obvious result that more power is obtained from the engine. Another function of the supercharger is to keep the engine developing sufficient power to hold the aircraft in the air at an altitude where the atmospheric pressure is so low that a normal unsupercharged engine would be starved of air. There is a limit to the altitude at which the supercharger can maintain sufficient pressure of mixture—or boost, as it is normally called—to allow the engine to keep the aircraft climbing. There is also a lower altitude where the boost will no longer stay at the setting fixed by the pilot, and it begins to drop. This is called the full-throttle altitude. When full-throttle altitude is reached it will, of course, still be possible to climb, but, as indicated above, the boost will gradually fall until the engine power drops to its lower limit.



It is the automatic boost control which has been gradually opening the carburettor valve during the aircraft's climb in order to keep the boost constant, despite the gradual reduction in the atmospheric pressure, and it is the point where the boost control unit has opened the carburettor valve to its full position that is called full-throttle height. Any further reduction in atmospheric pressure the boost control unit will be unable to cope with, and the boost pressure therefore begins to fall.

The Reason for Two Speeds

To obtain a higher full-throttle height two-speed superchargers have been introduced. The idea is to be able to run the supercharger, which is directly driven by the engine, at a sufficient speed to provide a constant boost up to a certain height, and then, as the full-throttle height is reached, to raise the speed of the supercharger by changing gear, and thereby getting a second full-throttle height a few thousand feet higher. It might seem that it would save having to design and build an elaborate gear change for the supercharger, if the supercharger was run at the high gearing all the time and a low gear was dispensed with. A supercharger, however, is driven by the engine at a very high speed, and a fair proportion of the engine's power is used up in this function; therefore it is desirable to use as low a gear as possible to give the boost required to conserve the power output of the engine. It follows that since the higher gear takes more power to drive it, the power obtained in higher gear above the lower full-throttle height will be lower than was being obtained in the other gear. One other factor which causes the power output to be lower in the high gear, when it is used at altitude, is because the mixture temperature is raised by the higher speed of the supercharger, and this lessens the weight of combustible mixture fed to the cylinders.

The Change-Speed Mechanism

The change-speed mechanism is usually operated by a two-position lever in the cockpit, and by means of friction clutches in the supercharger gear an effortless and smooth change can be made. Some engines even have an automatic mechanism which effects the change when the correct height is reached; in this case it is the atmospheric pressure which sets the mechanism in action. Incidentally, it is interesting to note how designers are striving to make engine control as simple as possible for the pilot, so that he can devote all his time to the operational duty assigned him; and when one considers that boost, mixture, propellers and two-speed superchargers can all be automatically operated, it must be agreed that they are having a fair amount of success.

Assuming that the two-speed supercharger is not automatically controlled, let us follow the pilot's actions from the time that he is at rest on the ground until he reaches his full throttle altitude in high gear. When he is running his engine up on the ground his supercharger change-speed lever will be set to give low gear. He may wish to satisfy himself, however, that the gear

(CONTINUED ON PAGE 21)

D'ye ken these?

Their names are listed on page 21

ANY man can drop a bomb to strike a target accurately for one set of conditions. He can be taught to line up three points—the target, the foresight and backsight—and to press the release switch. But when the conditions change he will not be able to adjust his sight line to the new conditions, unless he knows not only how to sight and release, but also why he so lines his sights and why the release switch is pressed at just that instant.

The bomb aimer knows that air forces are retarding and deflecting his bombs; he knows that his airspeed projects it forwards and gravity carries it down; that the drift of his aircraft is drift on the bomb. He knows that the bomb travels forward with the speed of the aircraft through the air, but he sights his target, using the aircraft's track and the ground-speed; the height at which the aircraft is flying he reads from his altimeter. He must correct it. The air-speed he reads off the indicator pointer is not true. To that he must also apply a correction. The outside air temperature affects all his calculations. It must be checked and used in his corrections.

Let us consider these things in some detail, so that we may appreciate more fully the heavy responsibility that is the bomb aimer's.

A bomb does not fall vertically as a stone falls down a well, but as a stone thrown outwards from a high cliff in a strong wind. Whilst attached to the bomb racks in the aircraft it is being carried forward at the true speed of the aircraft. When it is released it slowly loses that speed. Lose it, it must, no matter how slowly, since it has no motive power of its own to drive it forward. It will lag behind the aircraft.

A freely falling body in a vacuum gains speed at the rate of approximately 32 feet per second every second.

How long does it take? Sir Isaac Newton formulated the law governing freely falling bodies.

The distance a body will fall from a given height in a given time, he observed, is proportional to half the force of gravity multiplied by the square of the time that the body is falling.

But the bomb aimer wishes to know the time. The distance it must fall he knows. It is the true height of the aircraft. To obtain the time taken to fall he must transpose Sir Isaac Newton's formula.

This is not difficult. It need not be done each time a bomb is dropped. A simple formula has been evolved which states that the time of fall of a bomb from aircraft to ground is equal to a quarter of the square root of the height.

But this figure is only correct from low altitudes. From high altitudes another factor has an effect upon the bomb—terminal velocity.

It has been stated that gravity increases the speed of a freely falling body by 32 feet per second every second. Air resistance checks this acceleration. Depending on the degree of streamlining of the body, and its size, it will reach a point in its fall at which the pull of gravity is balanced by the air resistance encountered by the body. The speed at which this occurs is known as the terminal velocity.

What has size and streamlining to do with the terminal velocity? Streamlining is obvious. The better the shape for passage through the air the lower will be the resistance. But size—how can this change the terminal velocity for bodies of equal streamlining?

Consider it in this manner. A cube of one-foot sides weights one pound. It therefore has six square feet of surface area for one pound weight. Now, take eight such cubes and build them into a cube of two-feet sides. The surface area is now 24 square feet and the weight eight pounds; three square feet surface area for each pound of weight.

Obviously, then, the larger the bomb the less area it presents to air resistance per unit of weight which is acted on by gravity. So it will reach a higher terminal velocity.

Different conditions apply for the different type of bombs carried on the aircraft, and the bomb aimer must adjust his bomb sight for the various terminal velocities. A low terminal velocity gives the bomb more time to travel forwards, which means it must be released earlier than a bomb of high terminal velocity.

In practice the terminal velocity adjustment is made by tilting the backsight forward through the same angle as the bomb is known to trail behind the aircraft. The trail angle of a bomb is determined before the bomb is put into service, and the bomb aimer is able to correct his bomb sight for this error in the fall of the bomb before he reaches the target area.

At operational height, and approaching the target, he prepares to correct for the other factors which conspire to make the bomb fall wide of the target—wind-speed and lower air density.

With increase in height the density of the air decreases. The column of air pressing down on the aircraft at 20,000 feet is smaller than at ground-level. Not being compressed by so great a weight above, the particles have more elbow room and so press less on objects floating in them.

Temperature also affects the density. Cold air tends to descend. The particles crowd in on themselves during this descent, raising the pressure. Warm air tends to rise. Again the particles are given more elbow room, the pressure being lowered.

So we find that density decreases with altitude and rise in temperature, but increases with a fall in temperature.

How is the bomb aimer concerned with this? He must know his air-speed accurately so that he can predict the forward speed of the bomb as it leaves the aircraft. The air-speed is measured by means of a pitot tube, which measures the weight of air travelling over a series of small holes in a tube.

This reading of air-speed is not correct if the density of the air is lower or if the temperature has changed. The bomb aimer applies corrections to the instrument to obtain the true speed of the aircraft.

The same corrections for temperature and density must be applied to the altimeter to obtain the true height. For it is from the true height that the bombs will be released, not the indicated height, which is incorrect.

Density and temperature change rapidly with change of weather conditions. The bomb aimer must make his corrections in the target area, for everywhere else conditions are different.

The other factor which must be given serious consideration is the wind-speed and the direction from which it is blowing. At ground-level a wind of 40 miles an hour will uproot trees, blow tiles from roofs and do unaccountable damage. The ground has a retarding effect on the movement of air. Two thousand feet above the ground it may be double the strength of the ground-level wind. It is very much a force to be reckoned with at the bomber's operational height.

A bomber flying with a beam wind of 100 miles an hour is drifted downwind. So is the bomb. It has a forward velocity the same as the speed of the aircraft; it has also a sideways velocity equal to the speed of the wind. That bomb, sighted for a target directly ahead of the aircraft, would fall miles to one side.

If the wind is ahead the bomb will fall many miles short. If from behind it will fall many miles past the target.

The bomb aimer is well able to cope with this. He doesn't bomb on his air-speed. Although the air-speed is the speed of the bomb when it is clear of the aircraft it is not the speed at which it is travelling relative to the ground. Its velocity is a compound velocity made up of its forward speed through the air, its downward speed through the air and its speed and direction with the wind.

The bomb aimer finds the speed and direction of the wind at his operational height in the target area. He sets this on his bomb sight. From this he can calculate his speed relative to the ground, and he adjusts his foresight accordingly.

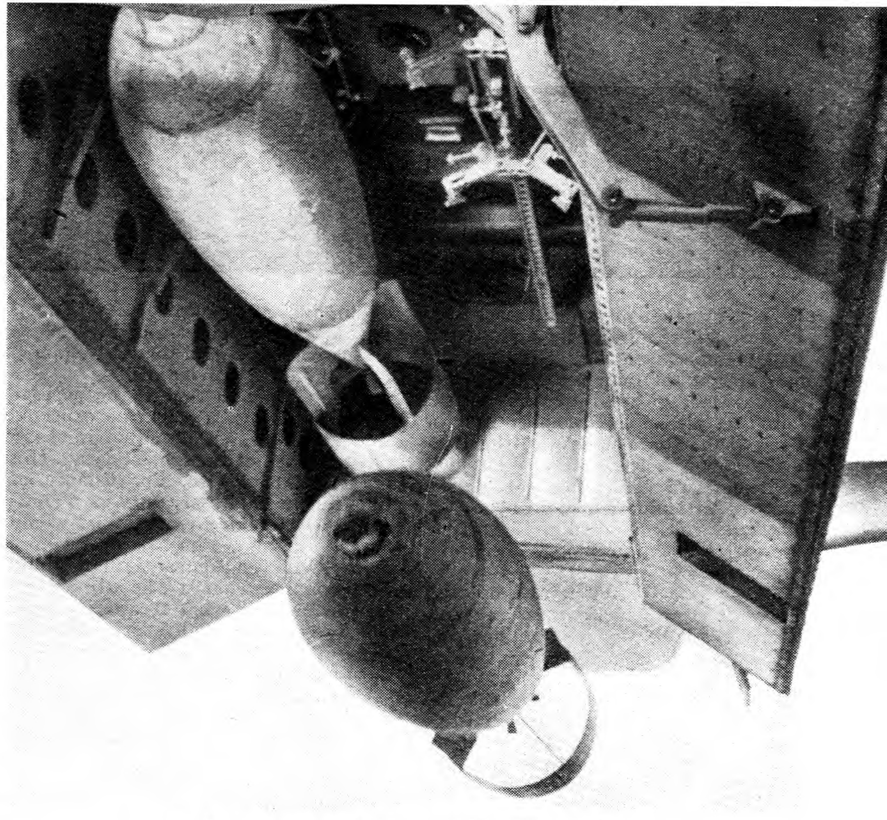
All corrections are made, the backsight has been tilted forward to counteract the trail of the bomb. The true air-speed has been computed from the indicated air-speed, the ground barometric pressure, the indicated height and the outside air temperature. True height has been computed from the indicated height, ground barometric pressure and outside air temperature. True air-speed and true height have been set on the bomb sight. Wind-speed and direction have been found. This also has been set on the bomb sight.

The bomb aimer is ready to attack the target. He gives corrections to the pilot to turn right or left, steadying, correcting, steadying, until the target is moving down the ground-speed bar. He must concentrate on the approach of the target to his sighting-line, but he is not unaware of the enemy's efforts to prevent him.

Seconds seem hours, but the target eventually lines up with the fore- and backsights. The release switch is pressed.

It seems easy: line up the target with the foresight and backsight and press the release switch. But there is a lot more behind it. Much careful work must be done before a flattened target is implied by *"Bombs gone!"*

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



The bomb release mechanism of a Boston in action.

Two-Speed Superchargers

CONTINUED FROM PAGE 18

change is working properly, as no experienced pilot ever leaves the ground without satisfying himself that his aircraft is functioning perfectly in every respect. To test the change on the ground he will move the lever to the high-speed position, whereupon he should see an immediate flicker of the boost-gauge needle which will indicate that the change has taken place. The flicker of the needle will have been caused by the slight delay incurred by the automatic boost control in rectifying the higher boost which the higher gear was trying to feed into the cylinders. On certain engines the change will be indicated by a flicker of the oil-pressure-gauge needle, since the change-speed mechanism is usually oil-operated, and the delivery of oil from the engine system to the supercharger to effect the change causes a momentary reduction in the engine oil pressure. The pilot will have immediately returned the control lever to the low-speed position when he noted that the change-speed was operating properly, and it will remain in this position throughout the take-off and climb. When he has climbed to his full-throttle height he will note that his hitherto constant boost will start to fall.

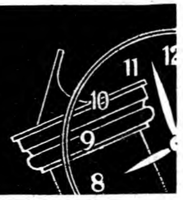
If he changed speed immediately he would gain no advantage due to the lower power obtainable from the high gear, for the reasons stated earlier. He therefore waits until he has climbed to quite a considerably higher altitude and his boost is getting a bit too low before he changes to high gear. The result will be that his boost will return to its original figure, and will again remain constant for quite a considerable period of climbing—in fact, until he reaches his second full-throttle altitude. Coming down he will change to low gear as soon as possible, and at all times he should use low gear in preference to high gear if he possibly can.

D'ye ken these?

(SEE PAGE 19)

1, I-15 bis; 2, Vultee-Stinson Vigilant; 3, Short Stirling; 4, Macchi C.200; 5, North American Texan (same as Harvard II except for equipment); 6, Bristol Blenheim IV; 7, Douglas Dakota; 8, Republic Thunderbolt; 9, Hawker Hurricane; 10, North American Mitchell; 11, North American O-47 B; 12, Handley Page Halifax II Series I; 13, Boeing Fortress IIs; 14, Armstrong Whitworth Whitley V; 15, Brewster Buffalo; 16, Fairchild Cornell; 17, Curtiss Kittyhawk; 18, Supermarine Spitfires; 19, De Havilland Mosquito II; 20, Fairey Fulmar; 21, Avro Anson; 22, Vought-Sikorsky Corsair; 23, Wackett Wirraway; 24, Fairchild 91; 25, Bristol Blenheims; 26, Martin Marauder; 27, North American Harvard II; 28, Douglas Devastator; 29, Consolidated Catalina; 30, Bell Airacobra.

Sunrise PUZZLE



MOST newspapers print each day the times of sunrise and sunset. In December each year a few people, more observant than the average, become rather puzzled by the curious fact that although December 21st or 22nd is the shortest day (in the Northern Hemisphere), the sun continues to rise later each day for almost another fortnight. Not until about the first week in January does it begin to rise earlier each morning as one would expect.

The reason for this is tied up with the way in which we measure time, but it really is not very difficult to understand.

In ancient times men used to tell the time of day by the sun, and the instrument they used was the sun-dial. Later, when reliable clocks were invented, it was found that sun-dial time was somewhat irregular. The length of one hour of time by the sun-dial was found to be slightly different at different times during the year. (We need not concern ourselves with the reasons for this peculiarity, except to note that one of the causes is the fact that the distance of the earth from the sun varies from day to day.)

It was decided, therefore, that instead of trying to make clocks keep this irregular sun-dial time they should be made to run at a steady rate which is equal to the average rate of sun-dial time over one year. This is the time on which all our civil clocks are based today, and for this reason it is often called "civil time."

Since this civil time is the average of sun-dial time, it might be expected that sometimes the sun-dial is ahead of it and sometimes behind it. This is just what happens. For instance, at the Greenwich Observatory, on February 6th the time by a sun-dial would be 14 minutes behind the observatory clock, while on August 14th it would be 14 minutes ahead. The astronomers have calculated what these differences are for each day in the year, and print them in a little table called "The Correction to the Sun-dial."

Now, suppose an astronomer at the Greenwich Observatory watches the sun rise and set each day during December and January, and records the time as it would be given on a sun-dial. His observation would look something like this:

Date		SUN-DIAL TIME *Sunrise*	*Sunset*
Dec. 2	-	0756 hrs.	1603 hrs.
Dec. 12	-	0805 „	1555 „
Dec. 22	-	0808 „	1552 „
Jan. 1	-	0805 „	1555 „
Jan. 11	-	0756 „	1603 „

From these observations he would conclude that the shortest day occurred on December 22, and that *by the sun-dial* the sun rose latest and set earliest on that day. Which, after all, is just what you would expect.

But these times are sun-dial times, not civil times, so the astronomer must correct them. He therefore looks up his little correction table and finds the following:

Date		*Sun-dial Time is*	
Dec. 2	-	11 minutes	FAST
Dec. 12	-	7 „	FAST
Dec. 22	-	2 „	FAST
Jan. 1	-	3 „	SLOW
Jan. 11	-	8 „	SLOW

Thus for December 2nd the civil time of sunrise must be 0756 hours, *less* 11 minutes, i.e. 0745 hours. Similarly, for the same day the civil time of sunset must be 1603 hours *less* 11 minutes, or 1552 hours. The astronomer's final table of sunrise and sunset in civil time would therefore be as follows:

Date	CIVIL TIME *Sunrise* *hrs.*	*Sunset* *hrs.*	*Length of Day* *hrs.*	*min.*
Dec. 2	0745	1552	8	7
Dec. 12	0758	*1548*	7	50
Dec. 22	0806	1550	7	*44*
Jan. 1	*0808*	1558	7	50
Jan. 11	0804	1610	8	7

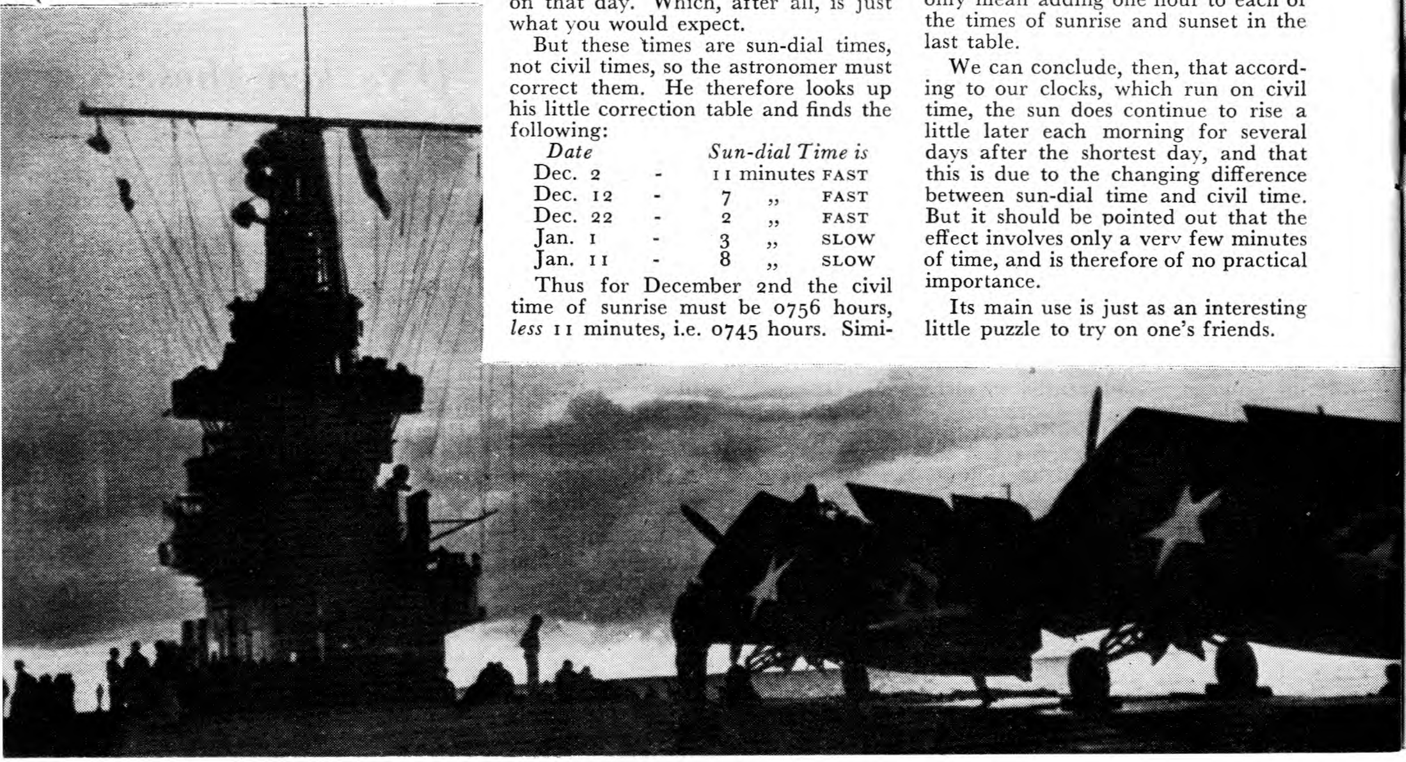
This table, being in civil time, would be the type of table used by people living in London. The third column has been formed simply by subtracting the time of sunrise from the time of sunset. From this third column it is clearly seen that December 22nd was the shortest day, the sun being above the horizon for only 7 hours and 44 minutes.

But look what has happened to the times of sunrise and sunset. As a result of correcting them to civil time the sun no longer appears to have risen latest and set earliest on the shortest day. According to civil time it rose latest about January 1st (0808 hours in above table), while it set earliest about December 12th (1548 hours in above table).

These dates will vary between places at different latitudes, and will also change a little from one year to another. (For instance, the shortest day in the Northern Hemisphere occurs sometimes on December 21st, sometimes on December 22nd, the difference being only a matter of seconds.) But the phenomenon occurs on the average as shown above. It is not affected by changing clocks to British Summer Time, as this would only mean adding one hour to each of the times of sunrise and sunset in the last table.

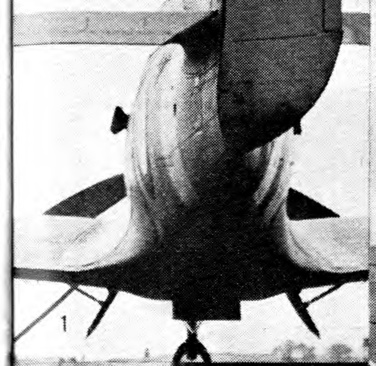
We can conclude, then, that according to our clocks, which run on civil time, the sun does continue to rise a little later each morning for several days after the shortest day, and that this is due to the changing difference between sun-dial time and civil time. But it should be pointed out that the effect involves only a very few minutes of time, and is therefore of no practical importance.

Its main use is just as an interesting little puzzle to try on one's friends.



Noteworthy details

OF AIRCRAFT
named on page 24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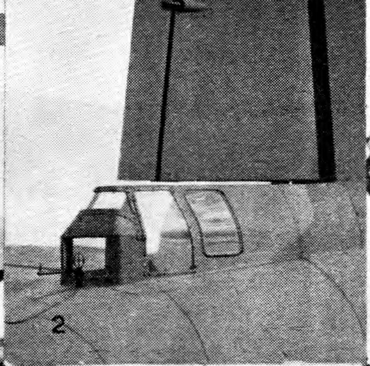
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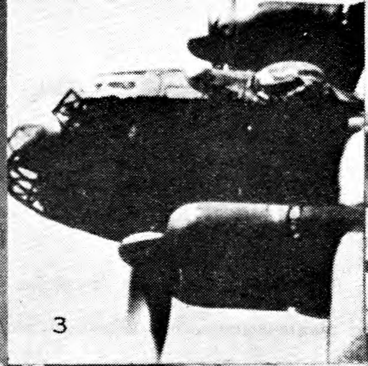
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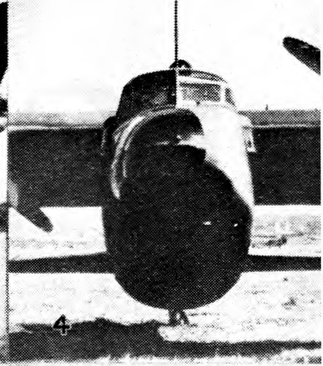
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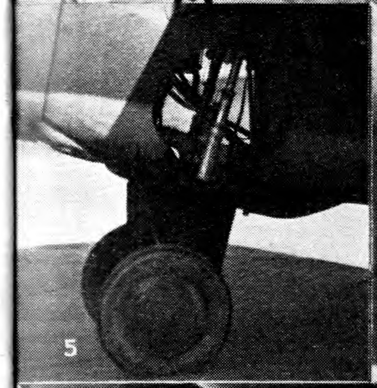
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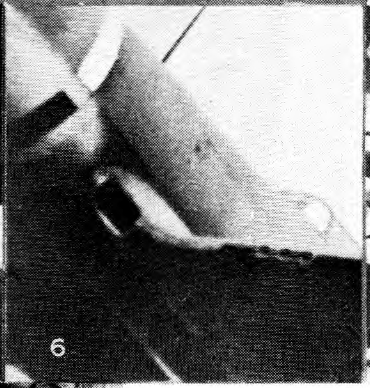
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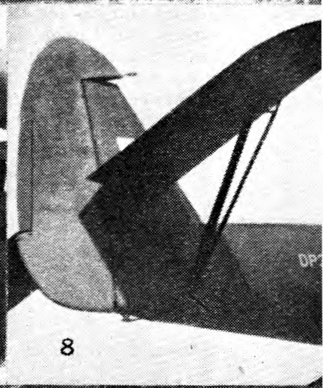
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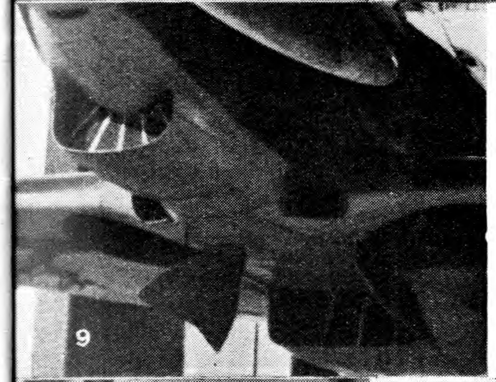
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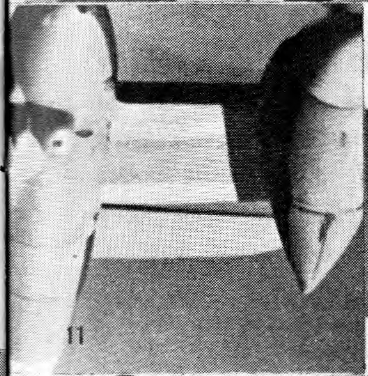
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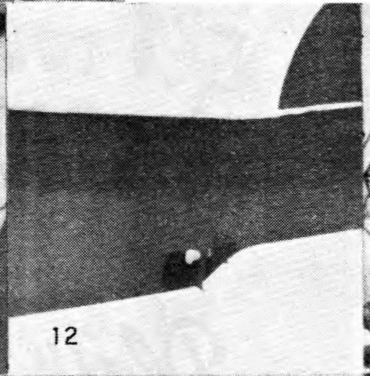
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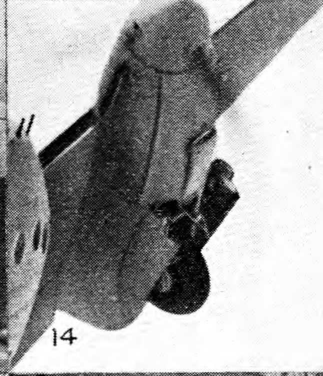
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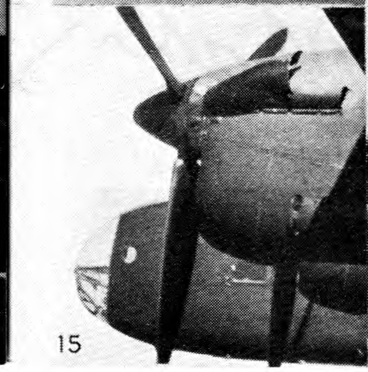
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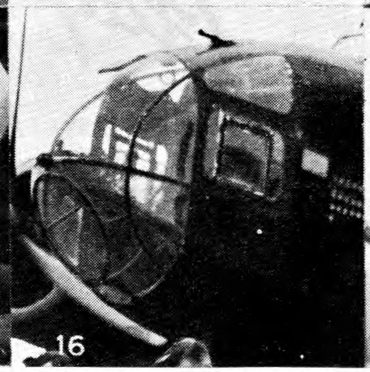
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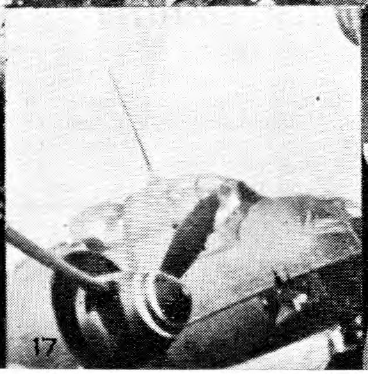
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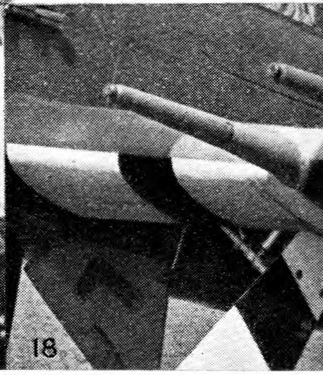

18

BOOKS

by B. J. HURREN

An Introduction to Principles of Flight
By W. F. Ware, B.Sc. 4⅞″ × 7¼″. 158 pages. Macmillan & Co. Ltd. 3/-.

Specifically written and planned for cadets who wish to grasp the basic essentials of the principles of flight without wading too deeply into technical and theoretical matters, this book is recommended for its lucid and comprehensive study. The analyses and explanations go up to matriculation standard in mathematics. Modern aircraft feature in the studies of causes and effects. Well illustrated and with many diagrams.

The Flight Testing of Production Aircraft
By J. A. Crosby Warren, M.A., A.F.R.Ae.S. 5⅝″ × 8¾″. 132 pages. Sir Isaac Pitman & Sons, Ltd. 8/6.

Whether you are on the job of flight testing your own squadron aircraft by routine after inspection or new delivery, or whether you aspire to higher realms of test work, this book contains many valuable tips. It can also assist the experienced maintenance engineer and serve as a supplementary work to flying-training study.

Airframe Construction and Repair
By John T. Henshaw, A.F.R.Ae.S. 5⅝″ × 8¾″. 138 pages. Sir Isaac Pitman & Sons, Ltd. 7/6.

Describing metal stressed-skin aircraft, with many good diagrams, this work provides a good basic handbook of the construction of aircraft and repair practice for damaged parts. It possesses double value: for the embryo mechanic and as a groundwork book for a lecturer with practical experience.

A Concise Engineering Course
By Percy H. Miller, A.M.I.Mech.E. 5½″ × 8¾″. 169 pages. Sir Isaac Pitman & Sons, Ltd. 7/6.

A primer written for apprentices and trainees in the engineering industry. It contains a mine of information based on practical experience; unfortunately, the reader must dig industriously through some rather heavy and badly written sentences.

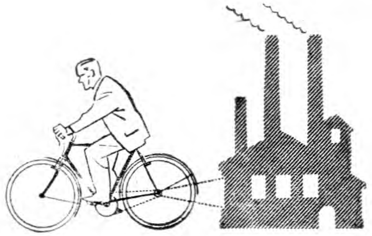
The Birth of the Royal Air Force
By Air Commodore J. A. Chamier. 10″ × 6¼″. 199 pages. 32 drawings of aircraft and maps. Sir Isaac Pitman & Sons. 15/-.

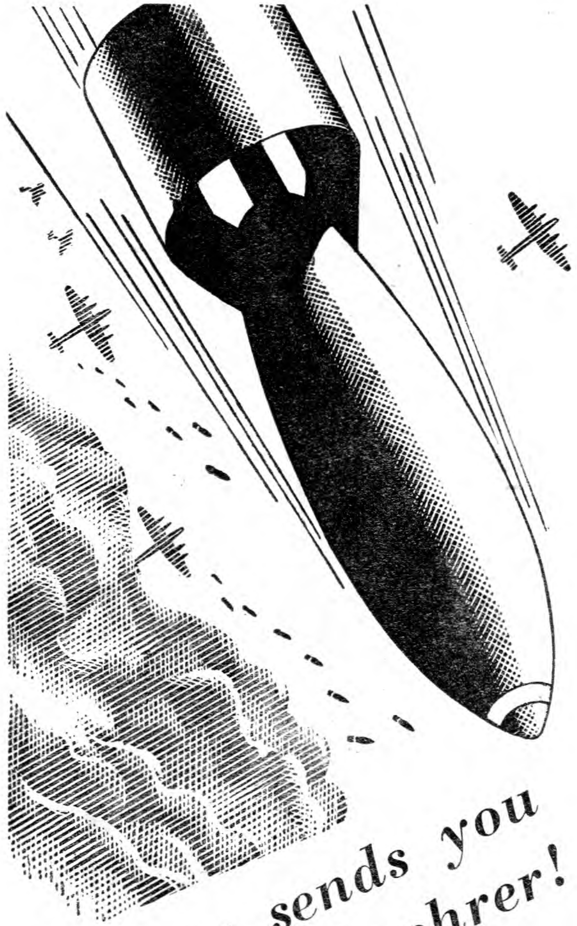
A concise history of the early days of the Royal Air Force has been needed for many years. The Official History is too long for most people, and most of the unofficial ones are inadequate. Air Commodore Chamier has dealt briefly but adequately with every campaign up to 1918. Though adequately stocked with facts from official records, the book has a vigour and style that derive their strength from a lifelong interest in flying and great experience of the Royal Air Force. It is well worth reading by everyone who is interested in the Service. The young will find in it much that is new to them, and to the older reader it will recall days of high endeavour and great enterprise.

Noteworthy Details

(SEE PAGE 23)

1, Bell Airacobra; 2, Boeing Fortress II; 3, Dornier 217 E2; 4, Blackburn Botha; 5, Grumman Martlet; 6, Vought-Sikorsky Corsair; 7, Vought-Sikorsky Kingfisher; 8, Airspeed Horsa; 9, Yak-1; 10, Brewster Buffalo; 11, Westland Whirlwind; 12, Lockheed-Vega Ventura; 13, Dornier 17 Z; 14, De Havilland Mosquito II; 15, Handley Page Halifax II, Series I; 16, Handley Page Hampden; 17, Junkers 88; 18, Hawker Typhoon IB.





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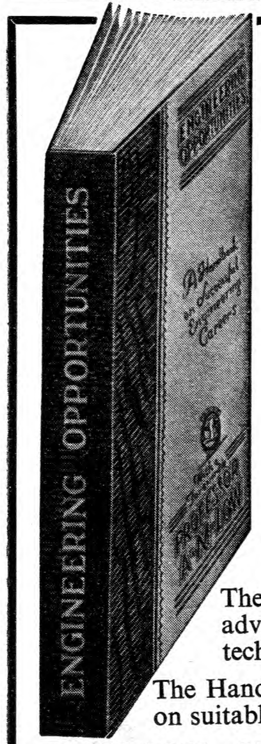

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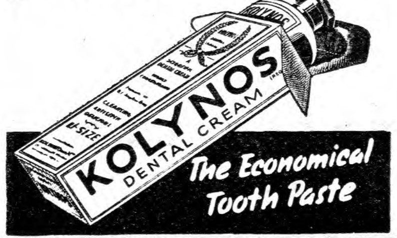

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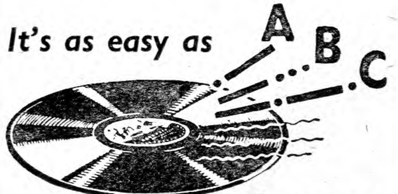

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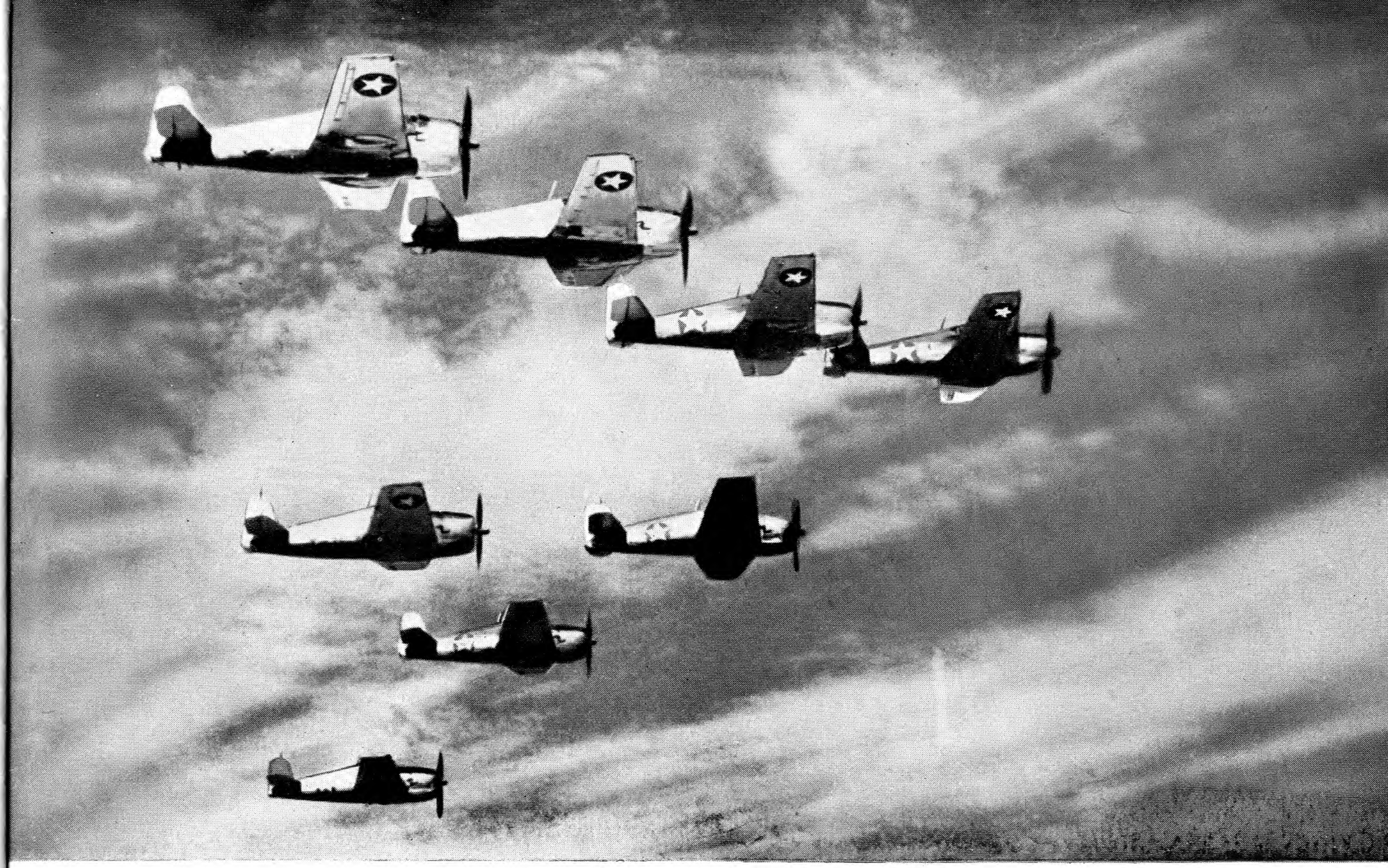

A flight of Grumman Hellcats.

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