Flying CADET

AVIATION FOR STUDENT AIRMEN

MARCH
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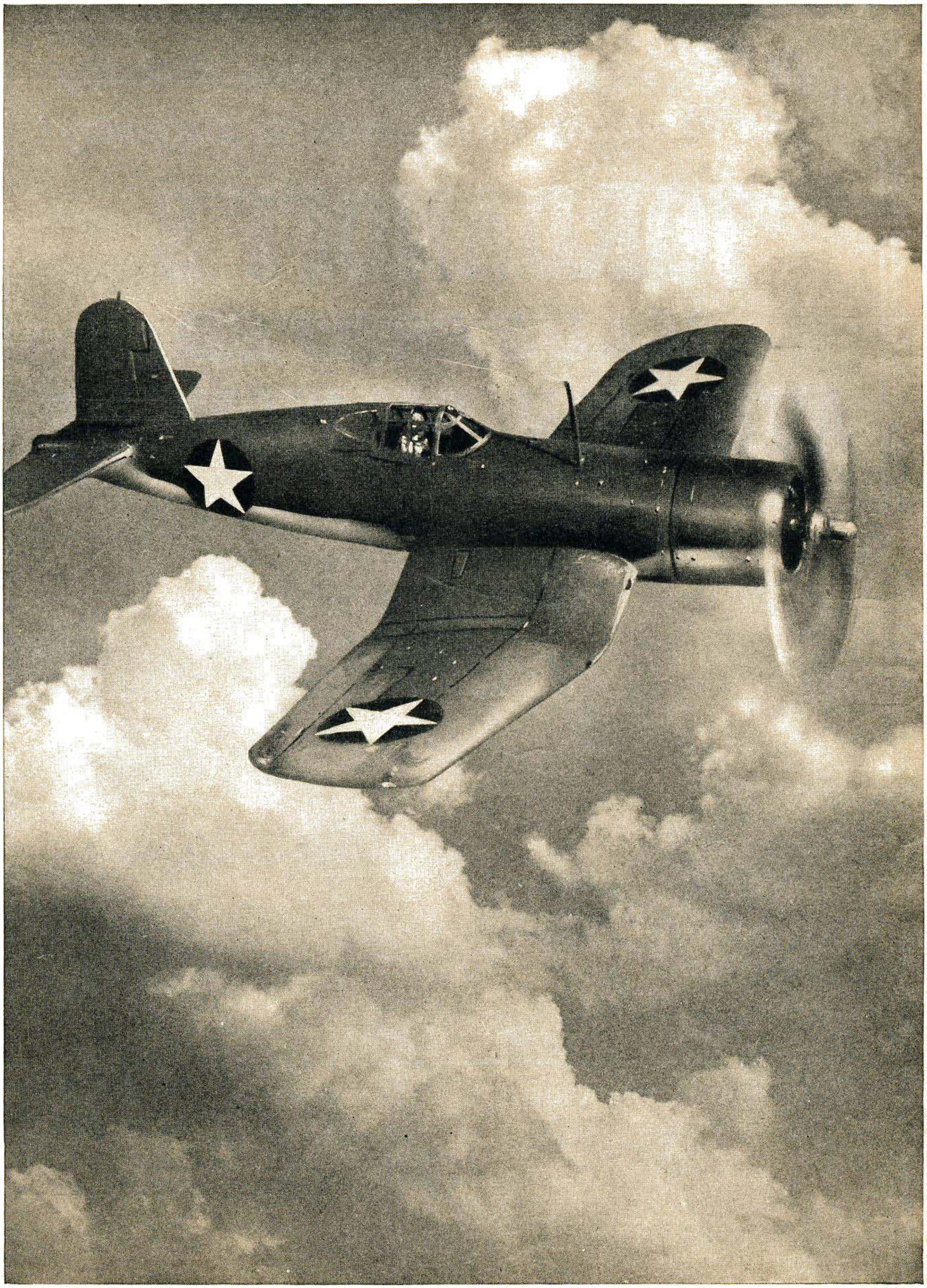
ARE YOU FIT TO BE A PILOT?
FIGHTER TACTICS · NAVIGATION
AIR HERO OF THE MONTH



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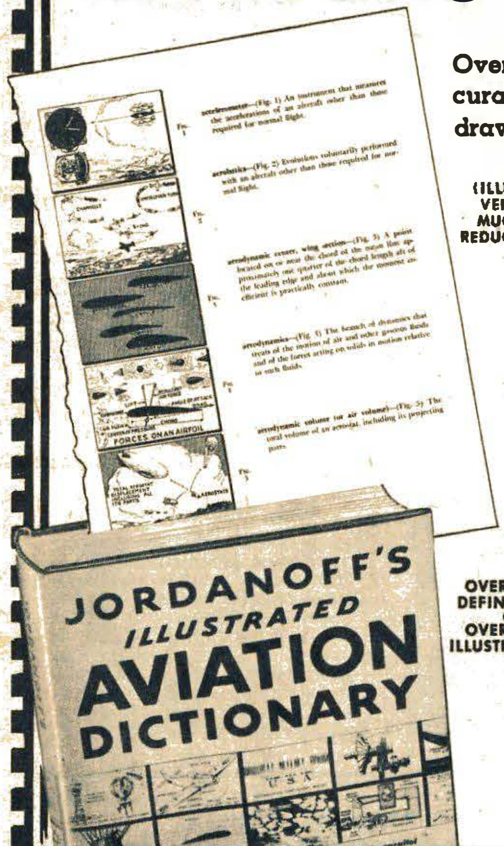

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Flying CADET

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Archer A. St. John, *Editor*

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A new view of the U. S. Army Air Force's Republic P-47 "Thunderbolt", single-seat high-altit de fighter, often called the "world's most powerful fighter plane". The "Thunderbolt" is powered by a giant 2,000 h.p air-cooled Pratt and Whitney engine, swinging a 4-blade propeller. The pilot shown is Lieut. Earl Hayward of La Grange, Ill.

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Fighter TACTICS

BY KEITH AYLING

Former R. A. F. Pilot and Author of "Flying Furies"

THE fighter pilot, riding the skies at 400 mph. and better, in his $50,000 mechanical marvel, is as near being a superman as any member of the combatant services. Sitting in an armored shell behind a 2000 hp. motor he climbs into the upper air at nearly a mile a minute and dives to attack at well over 500 mph. with the most deadly methods of destructive firepower at his finger tips.

In his cockpit, he looks more like a man from Mars than a human being, because science has taken over the responsibility of keeping him alive under conditions where the human system would normally cease to function. Protected by a bulletproof glass screen, wearing an electrically heated flying suit, with his face enclosed in an oxygen mask, he relies on various devices to keep him at the highest pitch of efficiency. Earphones and a throat microphone attach him to the ground or to his squadron mates by radio. A cleverly devised mirror visor gives him a view of the area above and behind him, and ground glass sight enables him to shoot at his enemy with an accuracy that would have seemed a miracle a few years ago. Attached to him is his parachute, that gives him a ninety-two percent chance of saving his life should his machine be disabled.

Compared with the scout pilot of World War I, the modern fighter pilot is one hundred times more efficient, but he fights on the same principles as those evolved during World War I, even if today increased speeds call for different tactics.

Air combat did not become a

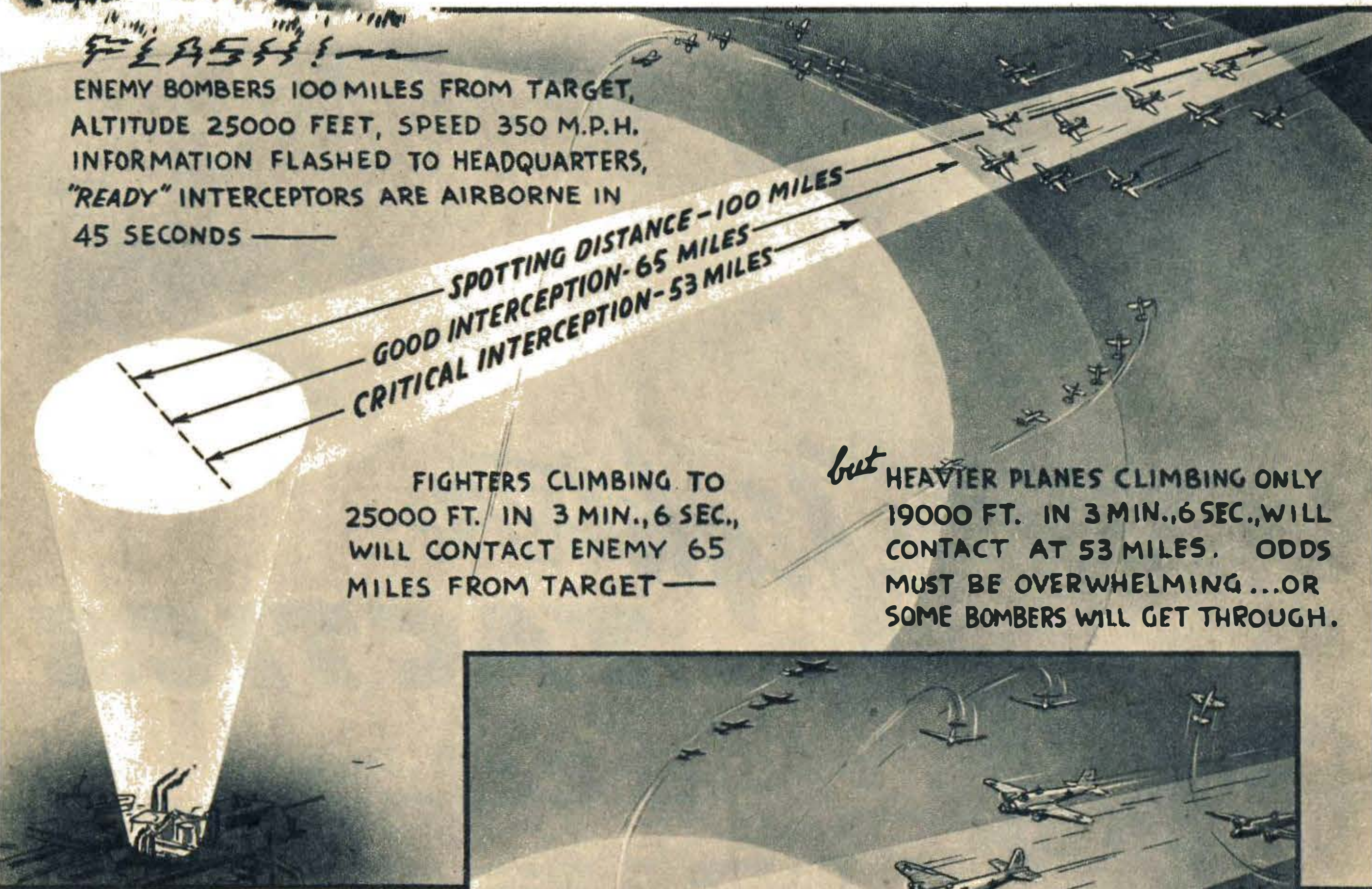
CONTINUED ON NEXT PAGE

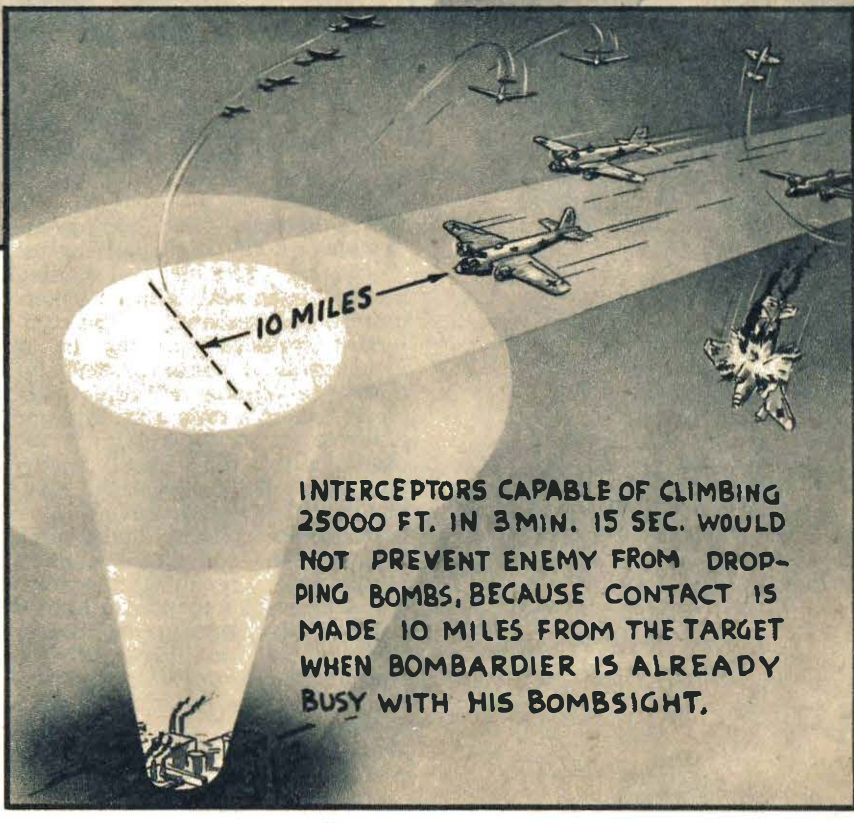
FIGHTER TACTICS

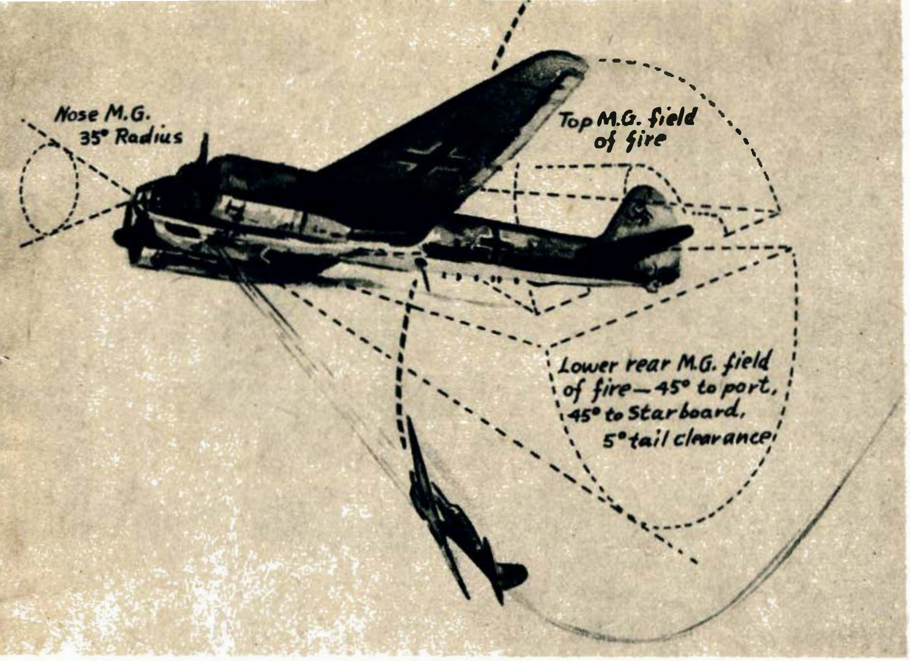
science until the first world war had been in progress for several years. In 1918, when the British, American and French fliers shot the Kaiser's airmen out of the sky, saw the beginning of formation attack, and multi-gun firepower. The last few months of the war brought the end of the individual air ace. Such men as Captain Ball, René Fonck, MacCudden, Bishop, Barker and Richthoven had blazed their names to fame over the entire world. From their brilliance other fliers learned much, but the outstanding lesson of those days was that union is strength, and that a flight or squadron of airplanes was capable of more destruction than the most brilliant individualist. Similarly, an ace aerial marksman supported by a squadron could do greater damage than when operating alone, and at less risk to himself, because of the protection given him by his escorts. Richthoven started the formation idea. He went hunting allied planes supported by his entire squadron. The British were thinking the same way, and soon there were massed clashes between formations of opposing fighters. In the Spring of 1918 500 scout planes fought a single action, with disastrous results to both sides.

These battles began the methods that still govern fighter operation.

The principle of fighter operation is attack. Fighters are used to intercept and defend bomber formations, and to destroy enemy fighters. The fighter pilot is only as good as the machine he flies. His plane must have height, speed and climb, heavy armament, armor, and a diving potentiality, equal to or better than his enemy. If his machine fails







him in any one of these, he is more or less a "sitting duck," however great his skill or extensive his experience.

Apart from his flight and combat training, he must have the ability to recognize at sight every known type of plane the enemy is likely to put into the air against him. Recognizing an enemy type is not enough, however. He must know everything about the machine—its fire power, the position and range of its guns, its blind and vulnerable spots, and the best angle from which he can attack it. Once he recognizes the plane he has to remember all these details and act. Flying at 400 mph. or more he has to think quickly.

Recognition of type will usually be supplied from the ground or by his squadron leader. The other information he must have at his finger tips.

Consider the task of a squadron leader engaged in bomber interception.

First, he must have height. To be at a greater altitude than the enemy is of paramount importance. Usually he will have the height and direction of enemy flight before leaving the ground. As he leads his swiftly climbing squadron to the upper sky, the ground station will give him any available information as to change of course or altitude.

The task ahead of the young squadron leader is tough, even with the support he gets from the ground. He must get his squadron in a position to intercept the enemy on its line of flight. He must bring his planes to a point of interception, some thousands of feet higher than the bombers which he knows are flying at 200 to 230 miles per hour. If he arrives a minute late at the point of interception the bombers may be out of sight, or may have slipped away on another course towards their target. If he arrives under the bombers and their fighter escort, he is in a dangerous position. If he gets to their line of flight ahead of them and on the same level he is inviting them to wheel on another course, and leave their fighter escorts to mix it with his squadron.

You can get an idea of how precise interception becomes when we imagine an enemy plane flying at 25,000 feet at a speed of 350 miles an hour. It is spotted 100 miles away from its target. The information is flashed to the airfield where the fighter squadrons are ready. The machines may have their engines ticking over, the "ready" pilots will be in their cockpits. Given 45 seconds, the fighter squadron can be "airborne." The point of interception depends entirely on how fast the pilots can roar to the same height as the enemy. If one type of fighter can climb to 25,000 feet in three minutes and six seconds a squadron equipped with such aircraft will make contact with the enemy when he is sixty-five miles from the city. A more heavily armed type of plane, that can reach only 19,000 feet while the others are climbing to 25,000 feet will get to grips with the enemy some fifty-three miles from the target. That distance is critical, because unless overwhelming fire-power can be brought to bear on the enemy squadron, some bombers are certain to get through. At such a distance the squadron leader can make no mistakes.

Should the defending squad-

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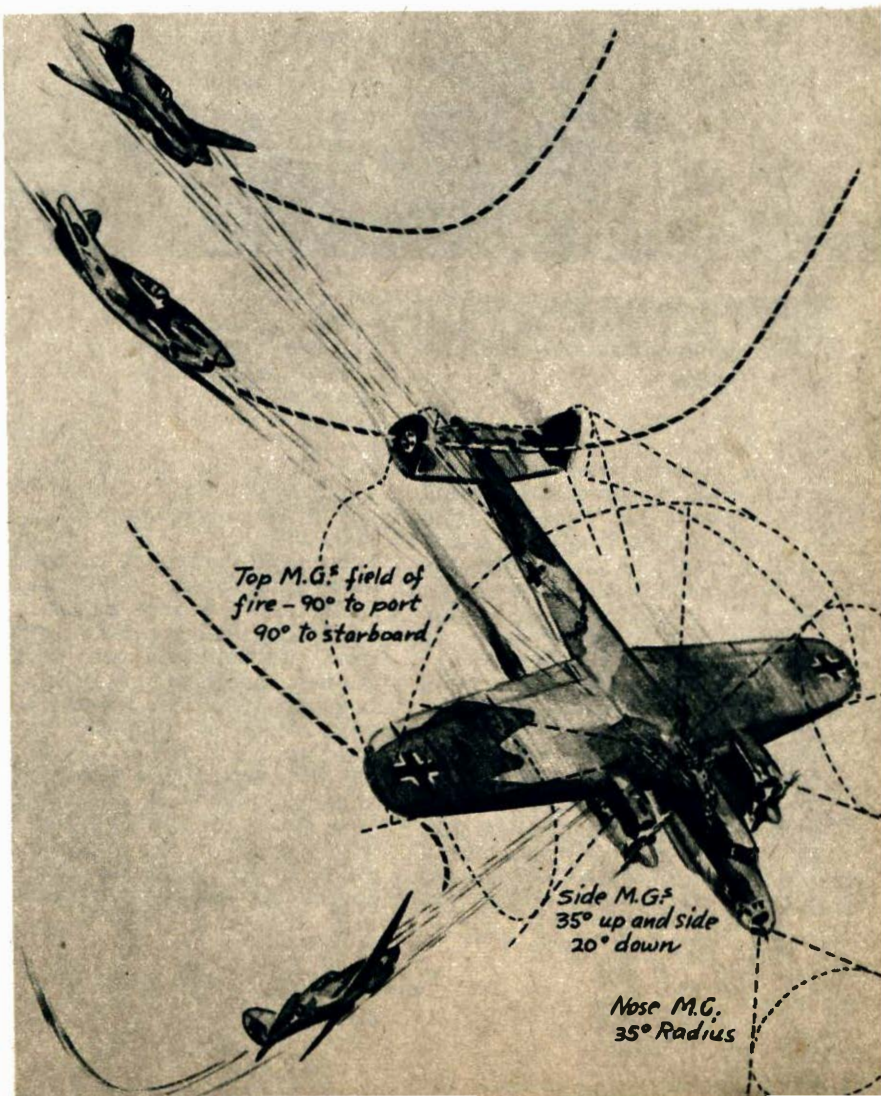


FIGHTER TACTICS

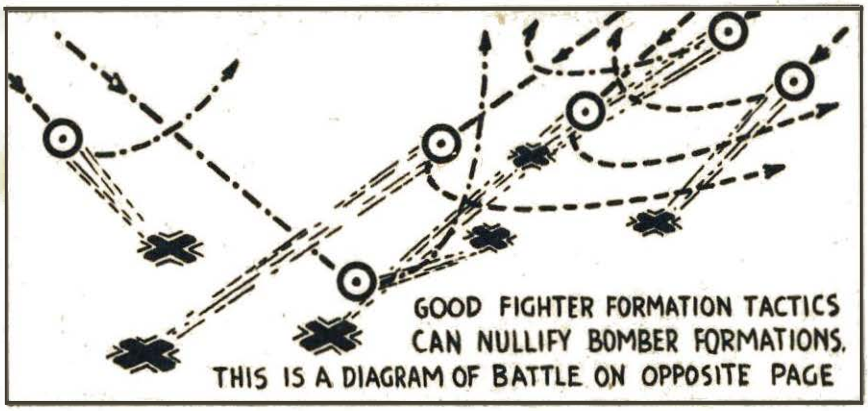
CONTINUED

rons be equipped with aircraft only capable of reaching 25,000 feet in three minutes-fifteen seconds, such interception would not prevent the enemy from dropping bombs, because the first contact would be made when the leading bomber was a mere ten miles from the target, when the bombardier would already be busy with his bomb sight.

Interception tactics are simple, yet infinite in variety. Bombers are usually escorted by fighters, whose task is to fight off the defending interceptors. The rule of thumb for the defending squadrons is to ignore the fighters, and go straight for the bombers, to disable them before they can get over the target area. Bombers are vulnerable to heavy machine gun fire. The trained fighter pilot knows the vital spots of each machine. He dives to attack. He may choose to give his first burst from the flank to "saw" off the bomber's tail at the thinnest part of the fuselage. To do this he dives out of the sun, holds his fire till he is within 100 to 50 yards of his target, and then gives the bomber everything he has in the way of shells or 50 calibre bullets. In this attack he runs risk of attack from the bomber's rear cockpit gunner, but the angle of his attack and his terrific speed are his advantage. As he pulls out of the dive, he climbs, turns over on his back and comes down again, either to finish off this bomber, or to attack the next in formation with a burst in the pilot's cockpit, or to the gas tanks. Such an operation takes place in a matter of seconds. After two such attacks a pilot usually finds himself a mile or more away from his enemy. Fighter tactics are essentially of the hit hard and run fast type.

René Fonck, the great French air ace, laid down a golden rule—that a fighter pilot must disengage from action after delivering the first blow.

When a formation of fighters attacks a fleet of bombers, each pilot knows exactly which machine he is to attack. At the order from the Squadron Leader the pilots "peel" off and go roaring into action. Sometimes the attack is made from the rear, so that the first three fighter pilots knock out the rear end of the bomber formation, or the center V of the formation may be attacked, in order to confuse the bomber pilots and break the for-



GOOD FIGHTER FORMATION TACTICS CAN NULLIFY BOMBER FORMATIONS. THIS IS A DIAGRAM OF BATTLE ON OPPOSITE PAGE

THE "FIGHTER" LIKE THE "SKEETER" AIMS AHEAD OF HIS TARGET

mation before target is reached.

Having fired his burst, the fighter pilot has to make his escape out of range of the bomber's fixed guns. He will avoid at all costs the front firing fixed guns. If there is an enemy fighter on his tail he will take evasive action. He knows that he must never fly in a straight line where an enemy gun can get him. Once his bomber victim is out, his task is to break action. He may sideslip sharply and come out in a dive, or fly at an acute angle away from his pursuer's line of flight and then slide in a flat turn which brings him round at an angle to the enemy plane. This flat turn tactic was used by the pilots of the German ME-110's when attacked by the more manoeuverable British Spitfires and Hurricanes. It looked clumsy airmanship, but it was effective.

Unless a bomber is heavily armored and armed, like the American Flying Fortress, it is easy prey for a fighter pilot. He is faster, he has more concentrated fire and can make short work of it. A favorite trick of a lone fighter pilot dealing with a bomber is to come up under the wing tips on either side, turn sharply in and give a big burst into the bomber's belly, immediately diving vertically underneath to avoid the fire of the bomber's gun. At all costs he must avoid circling at the same level as the bomber, thus offering himself as a target for its guns.

Modern fighter tactics are mainly on formation flying. Fighters fly in groups of six or twelve, either in V formation of three or four planes. In combat with other fighter planes the pliots work in pairs, one man protecting the other's tail.

When on offensive patrol, and anticipating attack from enemy fighters a squadron is often divided into close formation V's of three planes, with the fourth weaving round, above and below the open end of the V. The pilot of this plane looks for enemy planes and protects the tails of the others. When new pilots are getting experience, they often fly in the middle of a V formation, with a "tail-end Charley" weaving behind them.

Because the fighter plane has gained weight and is less manoeuverable than it was ten years ago, air fighting has become a matter of team work, directed by a quick, clear-thinking Squadron Leader.

A favorite method of attacking bombers by a squadron in formation, is for the first V of three planes to dive on the enemy. Such an attack can carry a staggering amount of destruction. Picture three of the latest twin motored fighters executing such an attack with all its guns firing.

They dive down at a sharp angle, taking as their target the first V formation of bombers. Each aircraft has four 20 mm. cannon firing from the nose of the nacelle, and four or six 30 calibre machine guns firing from the wings. At 500 yards the machine guns open with tracer bullets, to get the range. Then the pilots operate all their guns. Twelve 20 mm. cannon and twelve or eighteen 50 calibres blaze away. The leading bombers are quickly in flames. The attacking pilots dive under the bombers and zoom away to regain their height well out of range. Down roars the next V of three, aiming at the second element of the bombers. By the time the fourth section of the fighters has delivered its punch,

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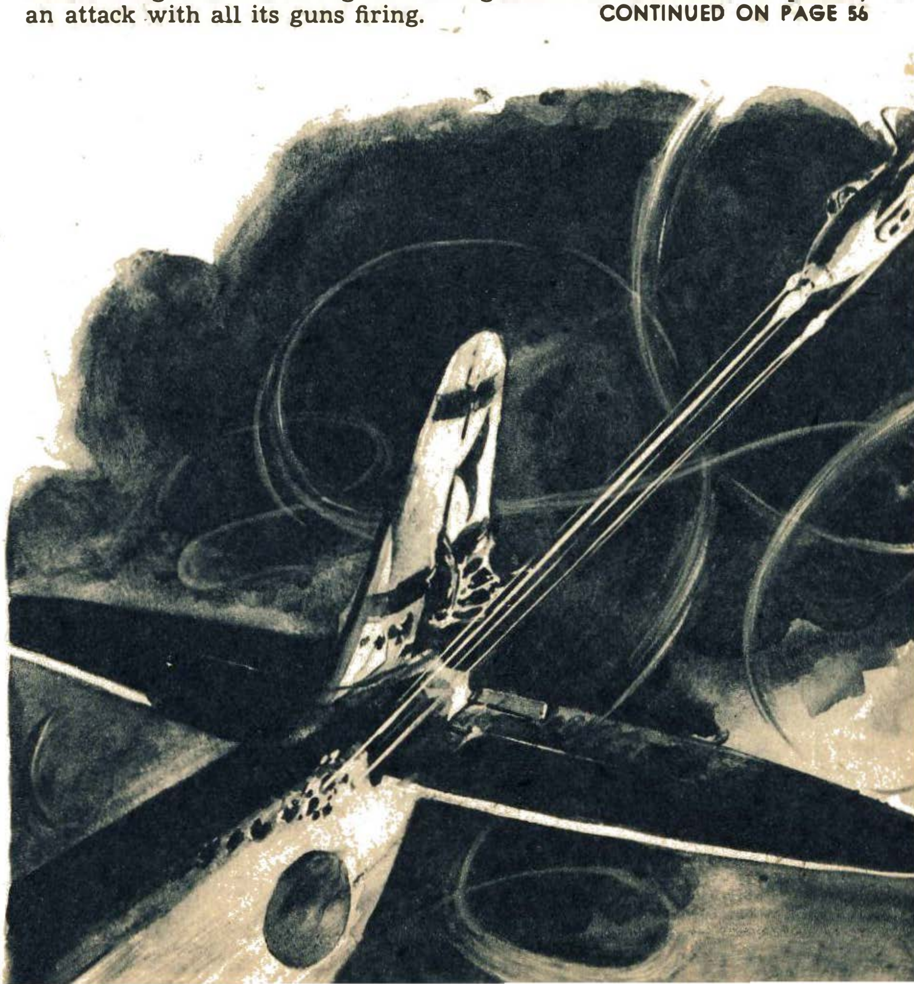

TRIGGERMAN

ACCURATE gunfire by triggermen in American bombers has been one of the chief reasons for the unusual success of American bombing missions into Naziland, paying high dividends for the Army's program for intensive training in the use of the machine gun, and resulting in the decision to make every member of the bomber crew an expert marksman, including even the radioman, mechanic and armorer.

To accommodate its expanded program of gunnery training, new schools have been opened at Laredo, Texas, and at Kingman, Arizona. Gradually, the Army will eliminate the career gunner (trained only in gunnery) in favor of the specialist gunner. Thousands will be turned out.

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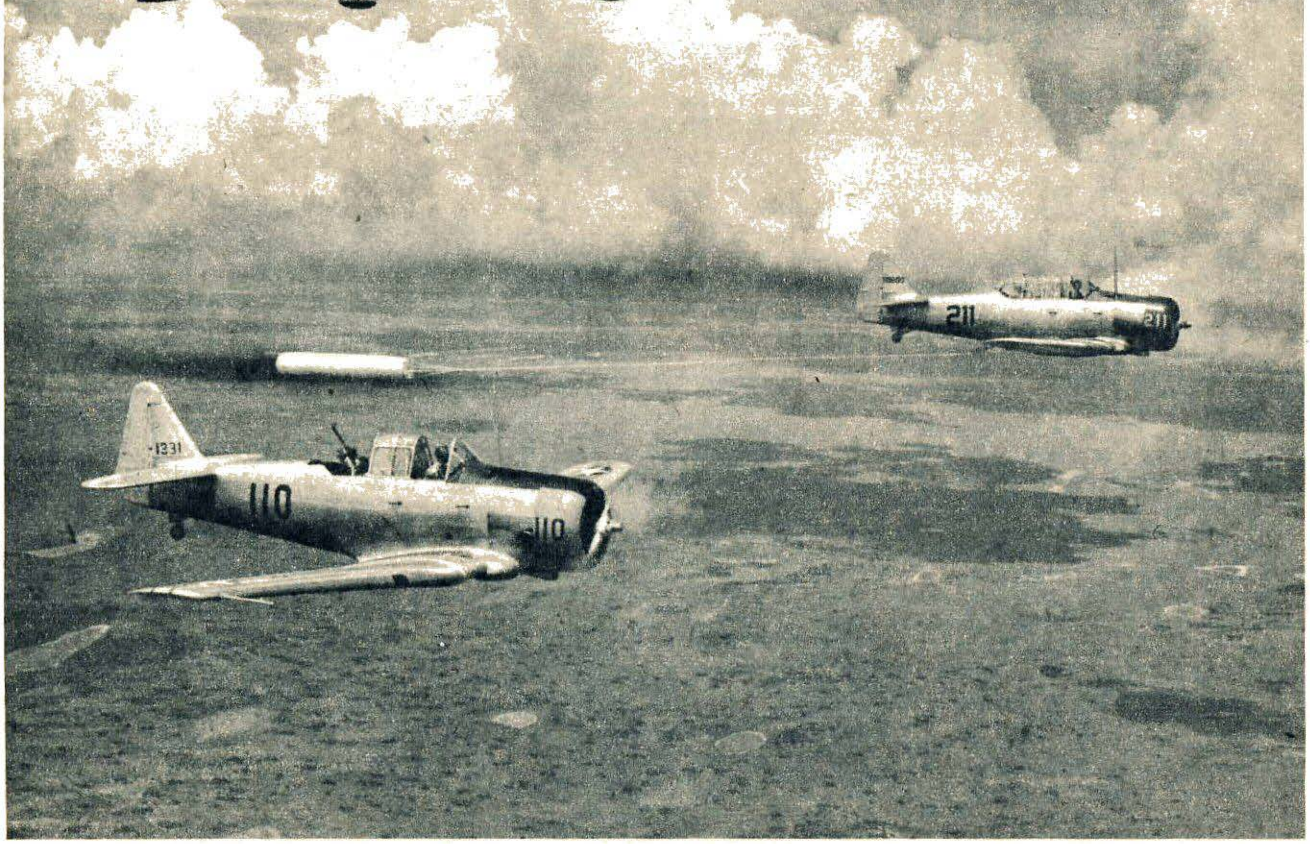
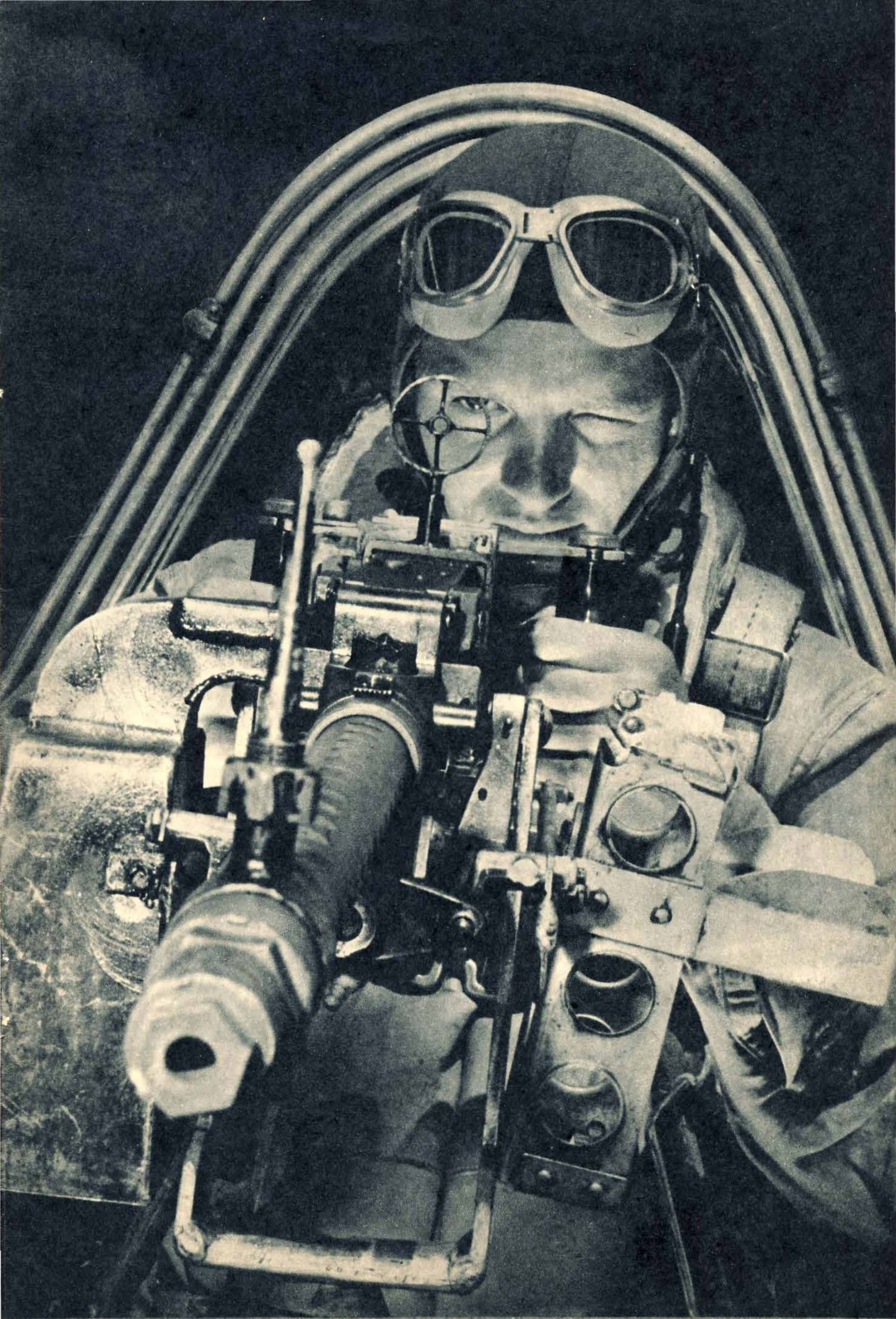


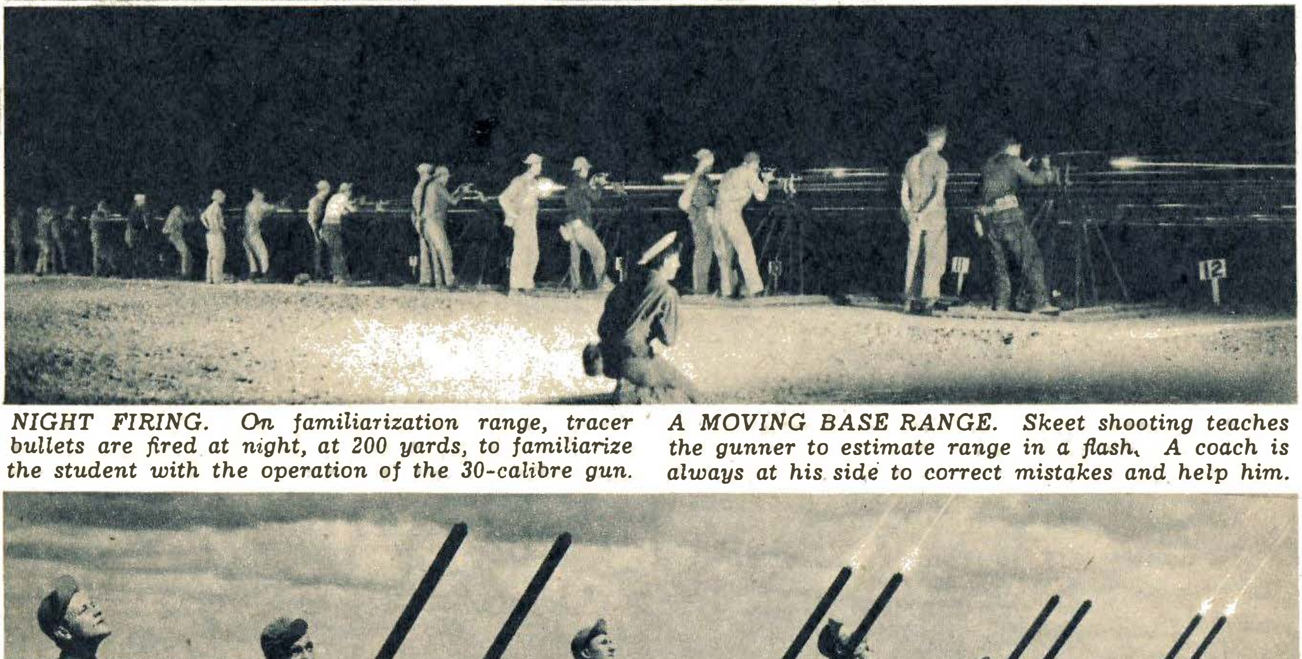
FINAL TRAINING comes after student has completed exhaustive courses in range firing; stripping, repair and maintenance of guns; ballistics; bullet patterns and aircraft recognition. Last week of five is spent in firing rear and turret guns of one plane, in tactical formation, at a cloth sleeve towed by another plane. Hits are recorded.



TRIGGERMAN

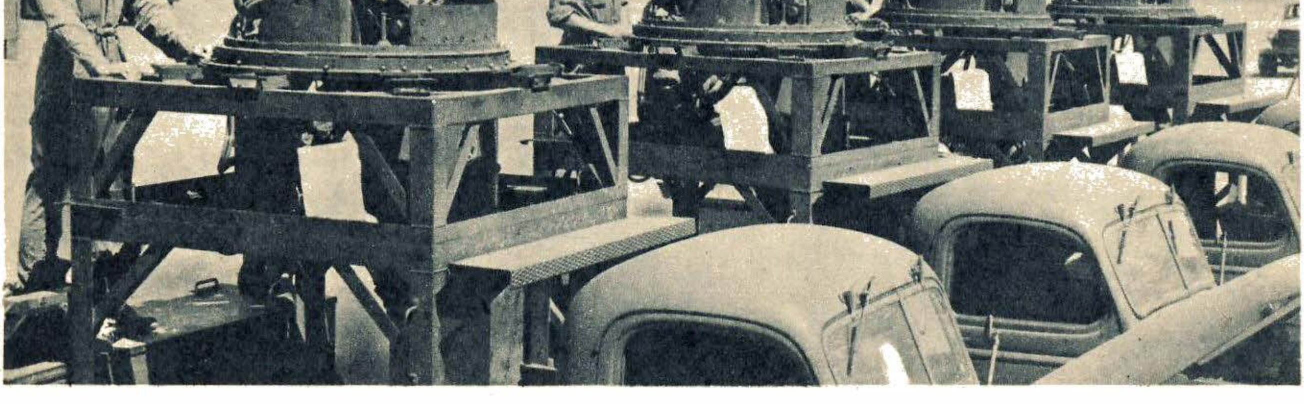
CONTINUED

MANIPULATION of reflex sights on Martin turret is one of most important jobs student has to learn. He must pass a written test as well as to be proficient in practice before he receives crewman wings and moves on to train with the rest of team.

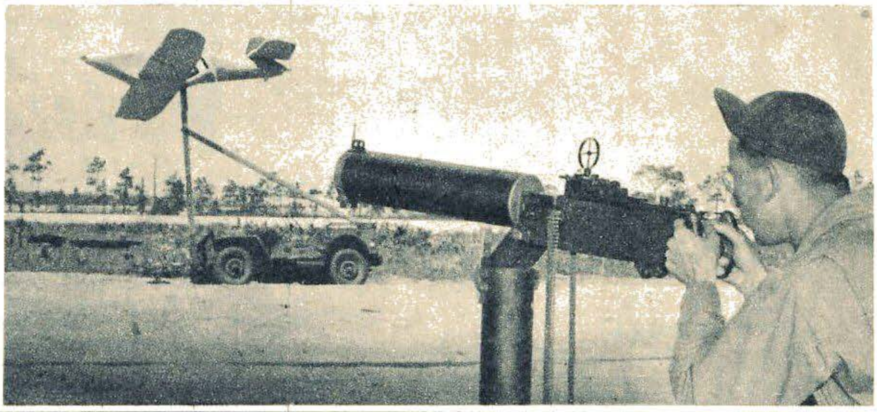


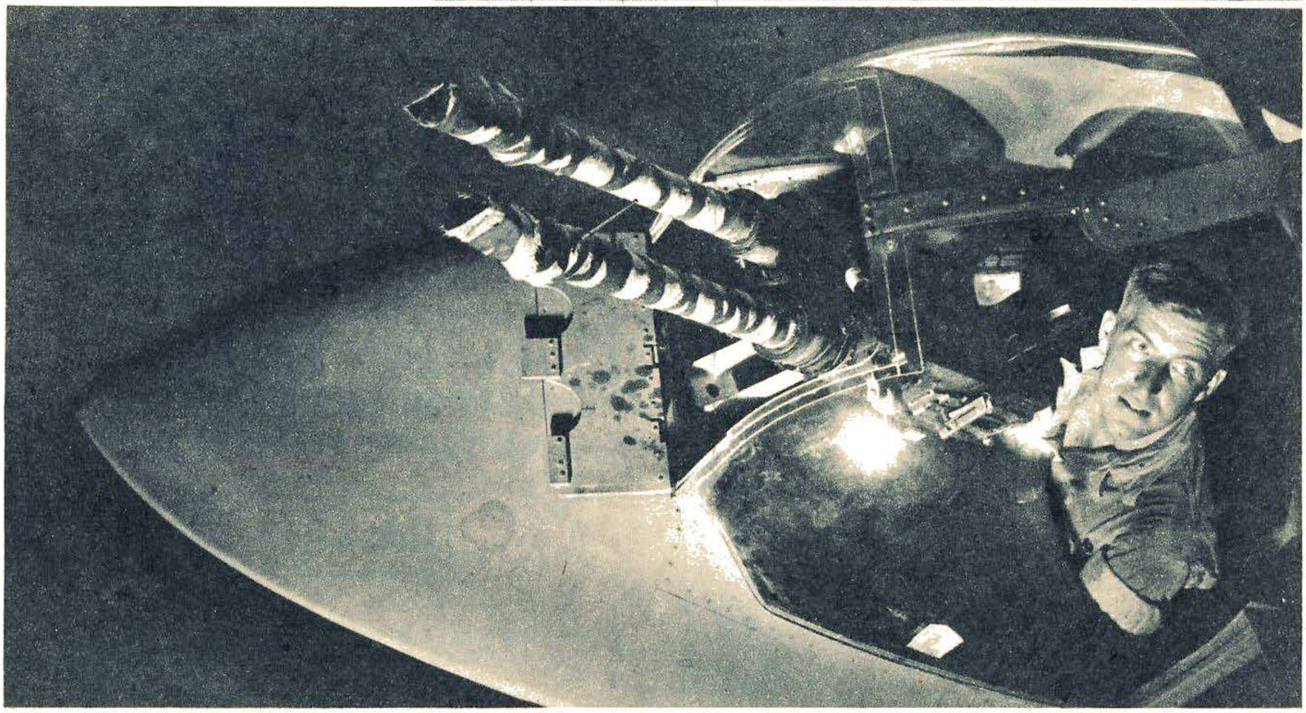
NIGHT FIRING. On familiarization range, tracer bullets are fired at night, at 200 yards, to familiarize the student with the operation of the 30-calibre gun.

A MOVING BASE RANGE. Skeet shooting teaches the gunner to estimate range in a flash. A coach is always at his side to correct mistakes and help him.



MOVING TARGETS are called jeep tracks at gunnery schools. The targets are mounted on jeeps which travel driverless around a circular track at about 35 miles an hour. Latest innovation is an electric beam gun which student fires at moving images on screen. It records score automatically. The noise and excitement of battle is simulated during this practice by means of sound recordings. Speed of targets can be regulated.

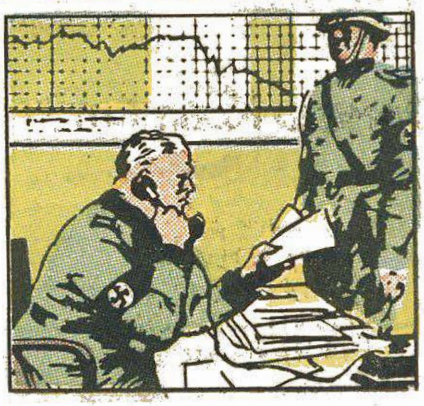





AIR HERO
OF THE MONTH
LET'S MAKE THIS SNAPPY, BOYS. I WANNA GET HOME FOR A WEDDING ANNIVERSARY!
MADE IN U.S.A.
BOMBED KOBE TO A "FARE-THEE-WELL"
DON'T FLY ANY LOWER, GRIFF - OR WE'LL CATCH US SOME FISHING BOATS!
THE "FLYING KID" - YOUNGEST PILOT ON THE MISSION. HE'S 21 —
FLEW SO LOW THEY HAD TO DODGE MASTS
MY CHEMISTRY TRAINING HELPED A LOT!
LIEUTENANT
GRIFFITA P. WILLIAMS
ONE OF GEN'L. DOOLITTLE'S BOYS - WHO BOMBED TOKYO IN A DARING DAYLIGHT RAID / WILLIAMS WON THE DISTINGUISHED FLYING CROSS AND MILITARY ORDER OF CHINA -
BORN IN SAN DIEGO - CAL.
DICK KIRSCHBAUM CAPTAIN - AAF

THE STORY BEHIND THE NEWS OF THE R.A.F.'s HISTORIC

ARMADA ATTACK



1. *GERMAN headquarters received a certain SOS for guns, tanks and planes which were urgently required on the Russian front.*

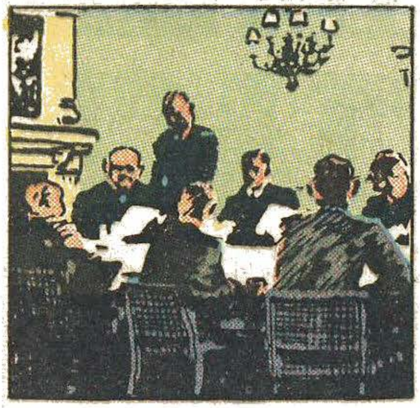
HOW THE R. A. F. LAUNCHED 1000 BOMBERS TO DESTROY SUPPLIES FOR RUSSIAN FRONT

An Intercepted Message Resulted in History's Greatest Raid

REVEALED here for the first time, in pictures supplied by the British Information Service, are the mechanics of a thousand bomber raid. Prepared on the spot by British artists, these sketches show some of the intricate organization that is required for putting a thousand bombers into the air, the reasons for selecting objectives and the results obtained.

Preparations for such a raid as the one illustrated on the following pages, and its actual conduct with clock-like precision and efficiency is one of the most difficult and complicated operations of modern warfare. Because of the speed of the airplane, all movements must be timed to the second.

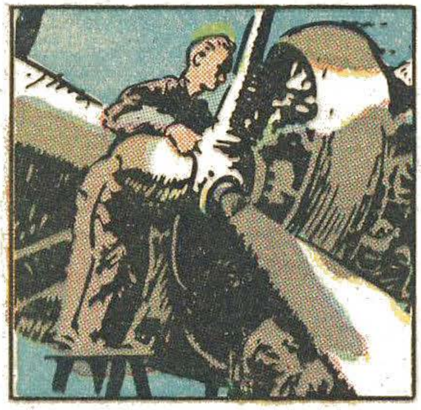
2. *BRITISH AGENTS intercepted the message and passed it on to London. Immediately the R. A. F. made plans to destroy the supplies.*



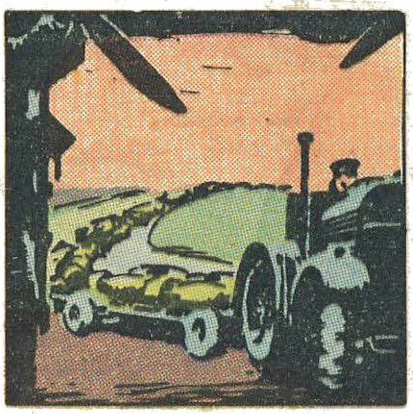
3. *WAR CABINET approved plan for launching the greatest bombing raid in history to smash German strength at its source.*

4. *DETAILS were worked out at the secret Bomber Command Headquarters which were hidden underground in a remote forest.*

5. *WEATHER CONDITIONS were checked and data obtained by girls of the Air Force Auxiliary at dozens of different airfields.*



6. *MECHANICS by the thousand were called for emergency service. to give engines a thorough inspection and last-minute test.*

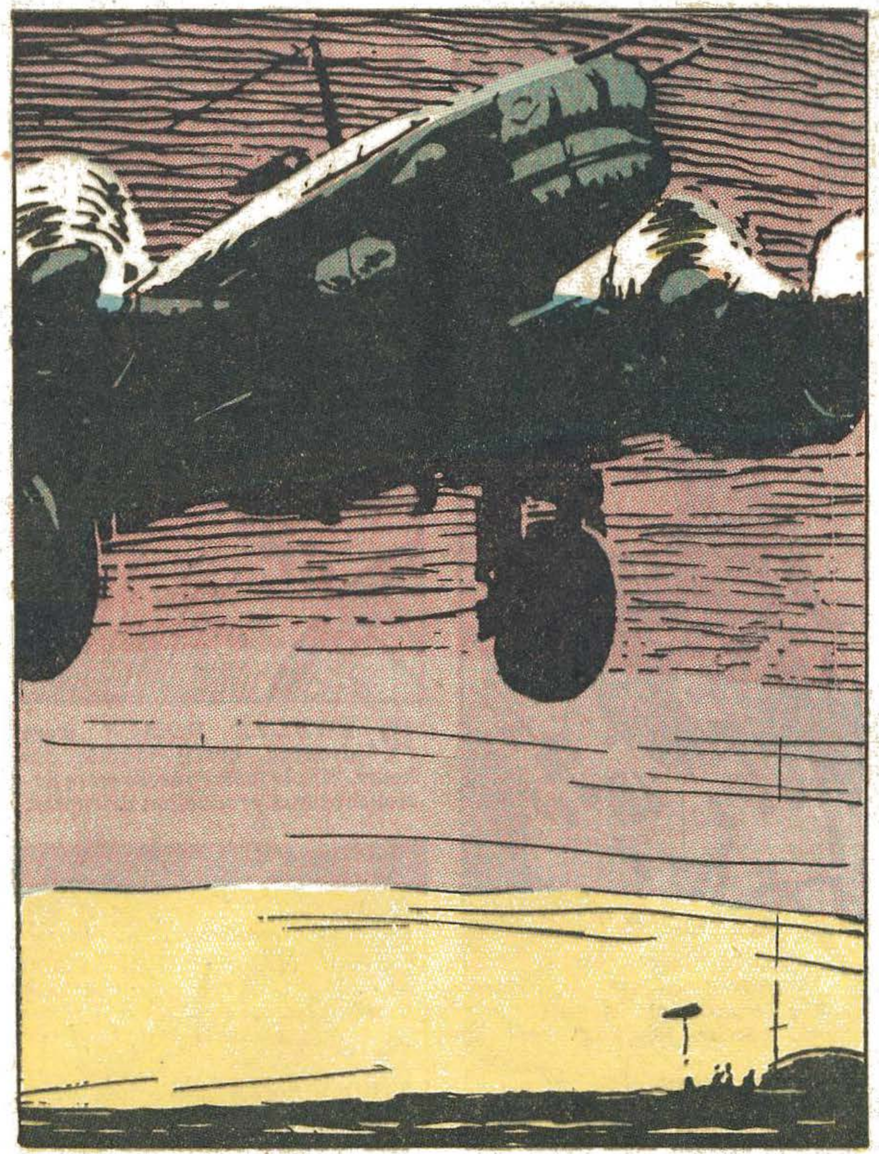


7. *BOMBS were hauled to the waiting planes by tractors! The largest bombers used in the raid carried loads of eight tons.*

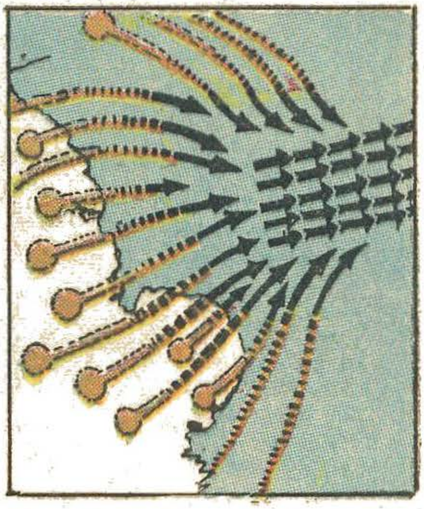
8. *AT THE LAST MINUTE, crews of the bombing planes were assembled and told of the part each plane would play that night.*

9. *SEVEN THOUSAND AIRMEN saw action in that hammering, night-long attack at Germany's vitals. The first planes left their home fields at dusk. Some airmen carried pets for good luck. One had a black cat.*

10. *ENTIRE PROGRAM was coordinated by the central command. The departure of each plane was directed by radio with clock-like regularity. Planes were coded in odd fashion. Pilots were in their planes, with propellers turning, waiting for a message like this: "T for Tommy. Take off"*



11. *HOUR AFTER HOUR throughout the night, heavily-laden, four-engine bombers rose into the air and pointed their noses toward the enemy across the Channel. The attack was ceaseless. The R.A.F. was determined on delivering a staggering blow that Germans would not soon forget.*



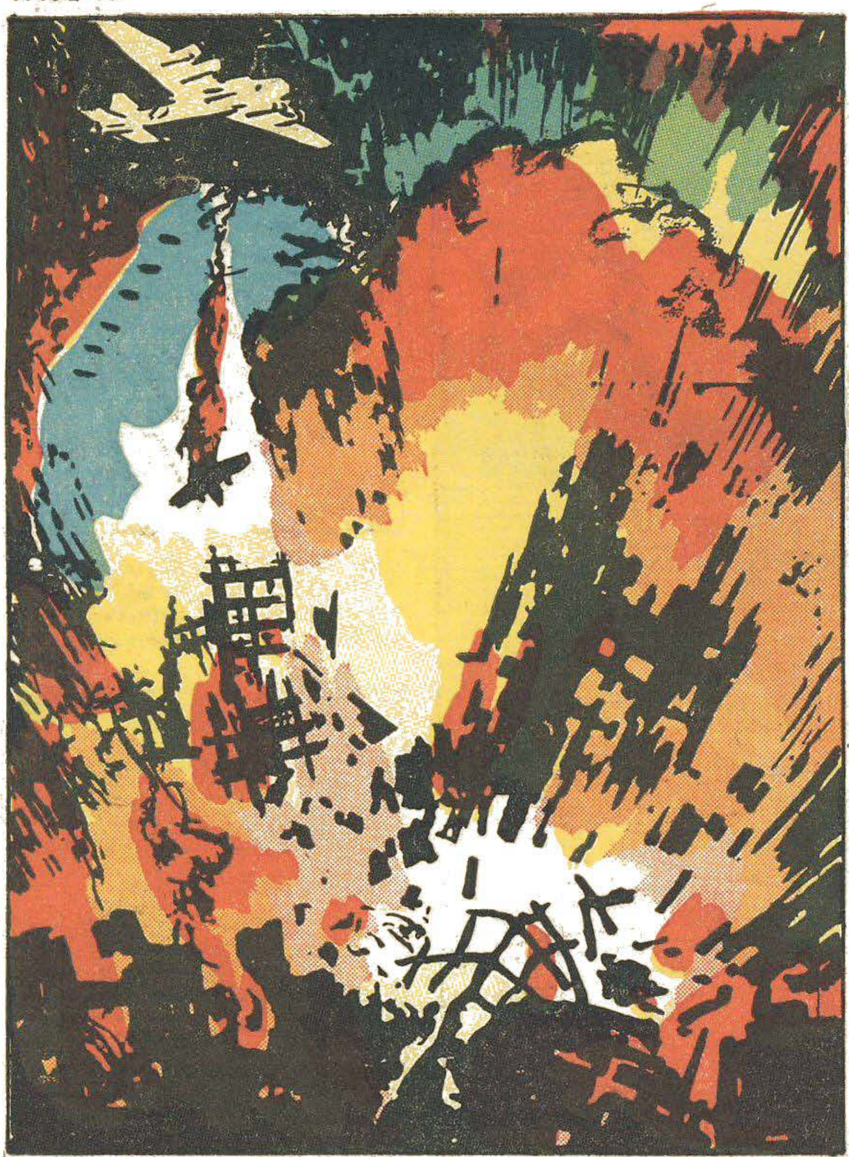
12. *MANY AIRFIELDS contributed to the overall scheme. A precise timetable gathered planes on time at a predetermined spot.*

13. *BEFORE RAID, British fighters had swept the skies to clear them of all enemy patrols that might attempt to intercept.*

14. *BRITISH FIGHTERS, flying low, shot up enemy airfields, harassed his communications, and disrupted defenses in general.*

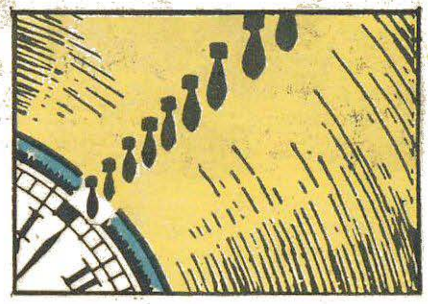
15. *SIRENS WAILED that night in Naziland, giving warning of approaching bombers. Night shifts stopped work and rushed to cover.*

16. *NAZI SEARCHLIGHTS stabbed the black sky, hunting for the bombers. Anti-aircraft gunners blazed away with little avail.*



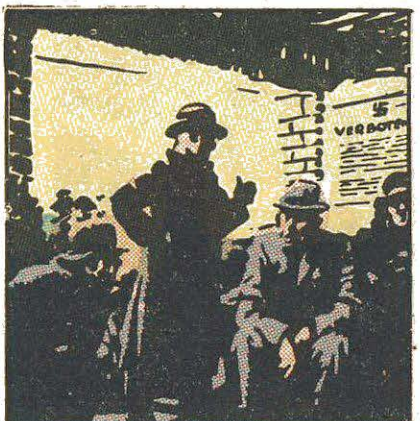
17. *ON TIME, the first squadron of bombers arrived over target area. These first planes carried only incendiary bombs. Thousands were dropped to start fires which illuminated the target. Bombardiers then sent down numerous high-explosives, which shattered many buildings.*

18. *ENEMY DEFENSES were confused by swiftly spreading fires which added to the destruction of block-buster bombs.*

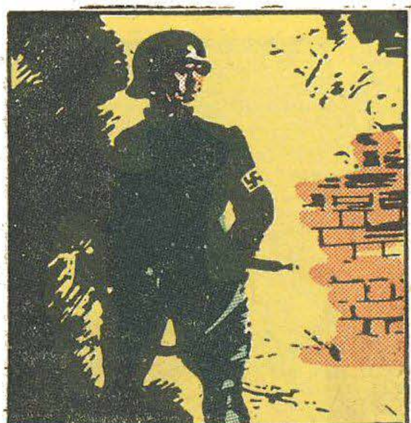


19. *TWELVE BOMBS were dropped every minute for hours. Whole factory areas were demolished and production disrupted.*

20. *ENEMY GUNNERS kept up a steady anti-aircraft fire. Hundreds of defending night-fighters were sent into the air.*

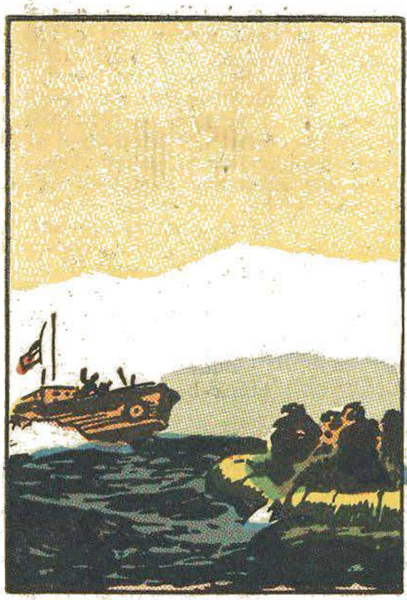


21. *GERMAN CIVILIANS huddled in shelters rocked by bombs. The R.A.F. was making a mockery of "invincible" defense.*



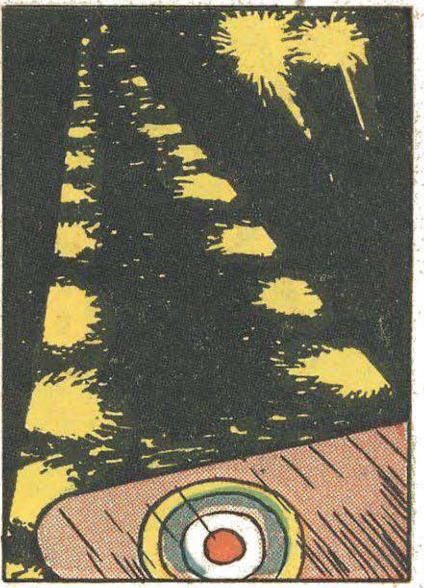
22. *TROOPS and S.S. men were called out to maintain order, prevent panic and try to restore morale of the alarmed people.*

23. *RETURNING PLANES were attacked by fighters. Some were shot down, their crews bailing out when unable to get home.*

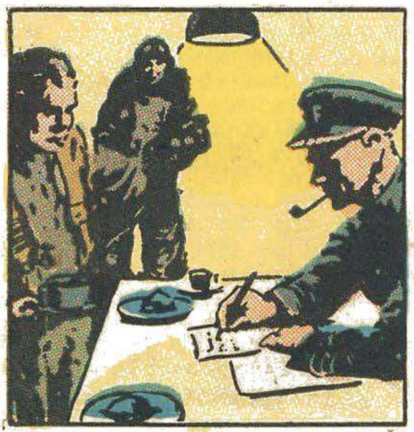


24. *UNHOOKING CHUTES, crewmen swim to their rubber boat and then float around in Channel until found by the rescue craft.*

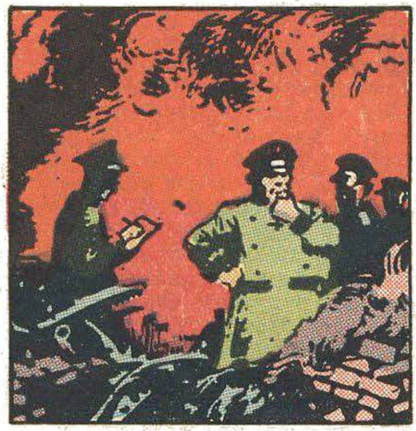
25. *TRADITION is for rescued flyer to give some small present to Auxiliary girl who packed chute which saved his life.*



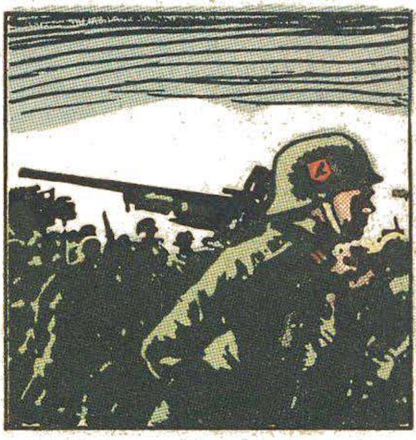
26. *RETURNING BOMBERS found their airfields identified by flares and runways marked by a series of evenly spaced lanterns.*



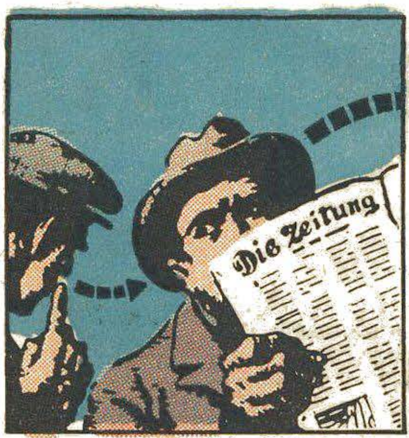
27. *EVERY PILOT made a report of what his ship accomplished, what fighters were encountered and of all ground observations made.*



28. *ON RECEIVING END the Nazis also made a report of the damage caused by the raid. Some of the fires burned for days.*



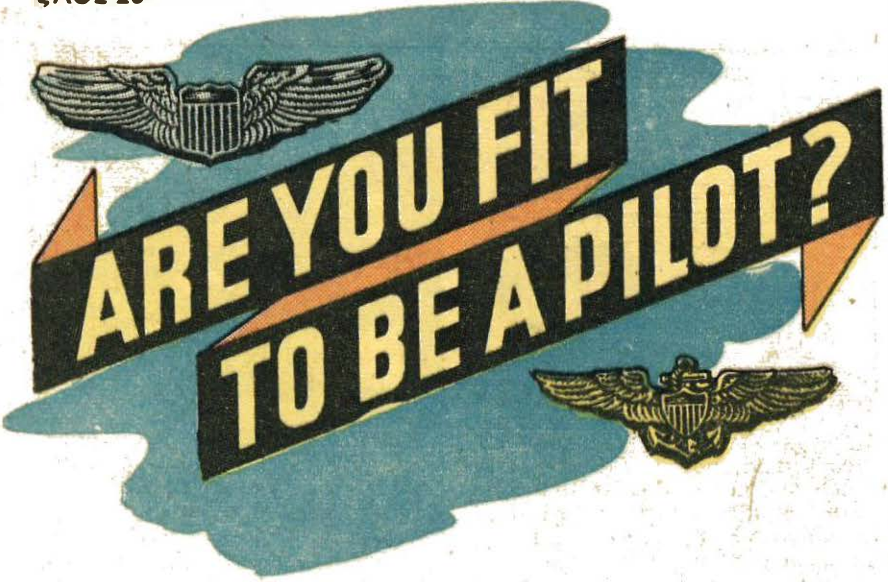
29. *GUNS AND AIRPLANES asked for by the Russian front were used, instead, to replace those destroyed in the air raid.*



30. *NEWS SPREAD throughout Germany despite precautions taken by Nazis. Evacuated civilians passed on word of destruction.*

31. *EVEN AT THE FRONT soldiers learned of raid, and failure of precautionary measures to prevent widespread damage.*

32. *FIGHTING in fierce cold on the Russian front, Nazi soldiers failed to get the needed weapons that had been promised.*



Compiled and edited by a well-known aviation writer and a flight surgeon who flies, ARE YOU FIT TO BE A PILOT! has been used in a number of communities for determining physical qualifications of candidates before they undertake specialized pre-flight training. Most young men do have the necessary qualifications to become pilots, but those who do not should be re-directed into other branches of aviation before they have set their hearts on their goal. In this book Dr. Erwin L. Ray and Stanley Washburn, Jr. provide all necessary materials for giving 12 tests which pilot-candidates must pass before they fly—either their own planes or those of the armed services. The tests on this and the following pages are samples from the book. ARE YOU FIT TO BE A PILOT sells for $1.50! in book stores, or may be obtained from the publisher, Wilcox & Follett Co., 1255 So. Wabash Avenue, Chicago.

WANT to find out for yourself if you are fit to be a pilot? In simplified form, on this and the following pages, are examinations you can give yourself, with the help of a friend, to determine how well you measure up to the standards Uncle Sam has set for his military airmen, and as a requirement for civilian and commercial flying.

These are a few of the tests which appear in the book "Are You Fit to Be a Pilot" by Dr. Erwin L. Ray and Stanley Washburn, Jr.

VISUAL ACUITY TEST

The first test is for visual acuity or sharpness of sight. In actual size, on the bottom of this page, are two lines of numerals. Place this page on a wall 20 feet in front of a chair in which you will sit. Place a lamp so that the light will shine up on the numerals but not back into your eyes. The official test specifies that lamps of 200 watts should shine on the card. The rest of the room should be dark.

In the book by Dr. Ray and Stanley Washburn is a complete nine-line, 20-inch card of numerals as prepared by the American Optical Company for official tests.

The Army and Navy require that a pilot candidate has 20-20 or better visual acuity. This means that with each eye separately he must be able to read the numerals in the line marked 20-20, at a distance of 20 feet, and without the use of glasses. If you are able to read the line of numerals marked 20-15, you have eyes far better than average.

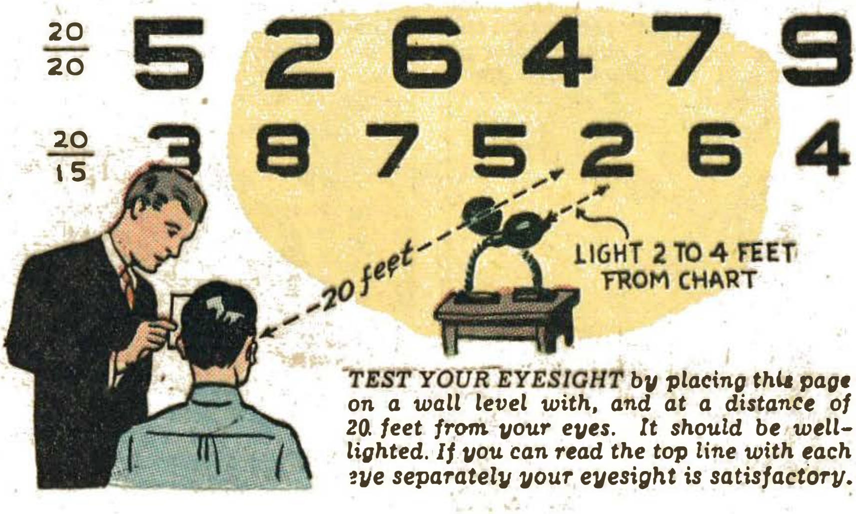
DEPTH PERCEPTION TEST

The next test is called a depth perception test. A black cardboard about eight by ten inches square is used as a window frame. The window measures two and one-half by seven inches. The window is located in the upper half of the black cardboard. Visible to the candidate through the window and against a white background are two black pencils. They are standing upright two and one-half inches apart and six and one-half inches behind the black card. One of the pencils is stationary and the other is moved straight forward, toward the window, or straight backward, away from the window, according to directions given by the candidate. The pencil is moved forward or backward by a helper.

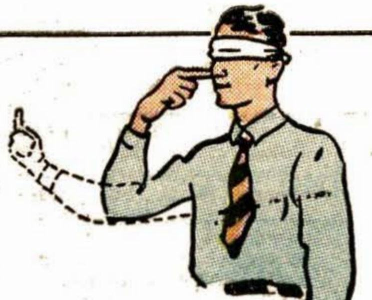
The candidate is seated on a chair 20 feet in front of the light box, so that his eyes are on a level with it. The rest of the room should be dark.

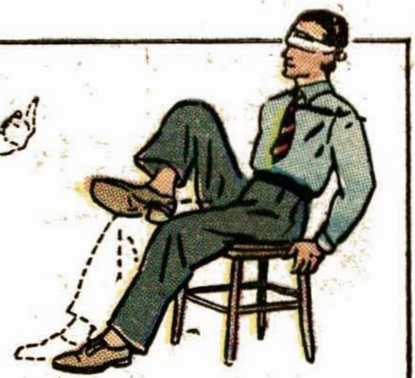
Lamps are used in this test so that light shines down inside the shadow box and against the white background. The lamps are shielded so that no light strikes the front of the pencils or the front of the shadow box. Both sides of the shadow box are also protected so that no light is reflected to distract the candidate. The top of the box is shielded so that the candidate cannot see the tops of the black pencils. The window has been located high on the black card so that the helper's hand moving the pencil never will be seen.

The purpose of this test is to determine the candidate's ability to recognize relative depth. The helper places both pencils so they are exactly opposite each other. The candidate is allowed to study the position of them for a few seconds. Then the helper moves



***TEST YOUR EYESIGHT** by placing this page on a wall level with, and at a distance of 20 feet from your eyes. It should be well-lighted. If you can read the top line with each eye separately your eyesight is satisfactory.*





EXAMINATION OF MUSCULAR COORDINATION

THESE three simple tests may be taken to test muscular coordination. The candidate should be blindfolded and told to stretch one arm out horizontally then bend his arm rapidly and touch the tip of his nose. He does this three times with each arm. Failure to touch the very tip is a miss.

Next the candidate is told to raise both arms so they are extended at his sides again. From this position he is told to swing his arms so index fingers are brought together in front of him.

In the next test the blindfolded candidate is seated in a chair with both feet squarely in front of him. He is told then to raise his right foot and touch his right heel to his left kneecap. The same things is done with the other foot.

A candidate has passed his muscular examination if he has more hits than misses.

one pencil in a straight line toward the window or further away from it. The candidate then directs the helper to move the pencil forward or backward until the candidate is satisfied that the two pencils are lined up. He is allowed 30 seconds in which to do this.

The distance is then measured between the point where the pencil is finally stopped and the line that would mean a perfect score, and a record is made of it.

The routine is altered slightly and the test is then repeated four times. All five scores are added and the total number of inches is divided by five to obtain the average score.

In similar tests, the Army and Navy require a pilot candidate to make an average score of not more than one inch, without glasses.

Dr. Ray and Stanley Washburn have provided in their book a graduated depth perception chart, black, gummed covering for pencils and the black face for the light box.

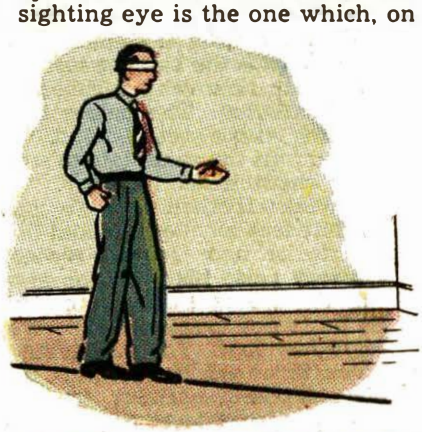
NERVOUS DISORDERS

Gait frequently will reveal nervous disorders which disqualify a pilot candidate. To test gait, the candidate walks a straight line, heel-to-toe and a straight line and a circle at his regular gait, with eyes open. Then he must repeat the performance blindfolded. When he has reached the end of the line blindfolded, or completed the circle, he must turn around and retrace his steps. If he becomes uncertain and unsteady he is disqualified.

OCULAR MUSCLE BALANCE

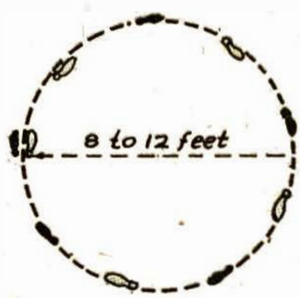
For this test a peep hole three-sixteenths-inch in diameter is punched in a large cardboard. A candle is placed on a table 20 feet in front of the candidate's chair. The candle is lighted and the rest of the room is made dark.

The candidate is seated in the chair and is given the cardboard with peep hole. He holds the card at arm's length and, with both eyes open, moves the card around until he can see the flame of the candle with both eyes. Then he slowly closes first one eye and then the other. The sighting eye is the one which, on



closing, causes the flame to disappear. This is the one, whether left or right, which the pilot will use the most.

After several tests have been made, as above, to be sure which eye is the sighting eye, the helper



MUSCULAR TREMOR is tested in several ways, one of them being to see if any tremor can be felt in the candidate's finger tips when his arm is extended, as shown at the left.

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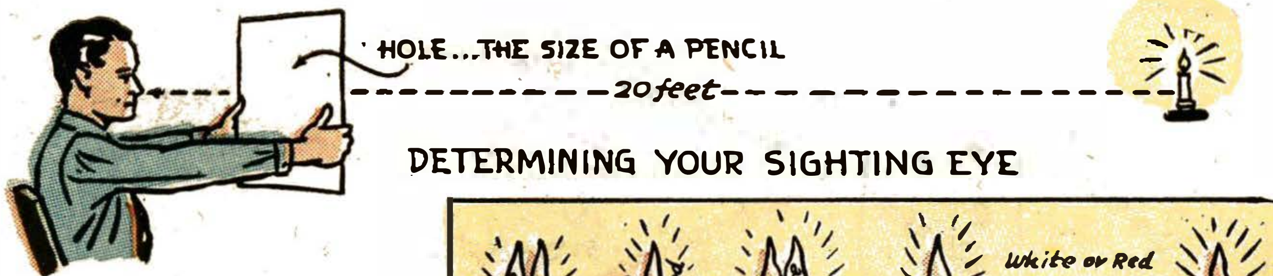
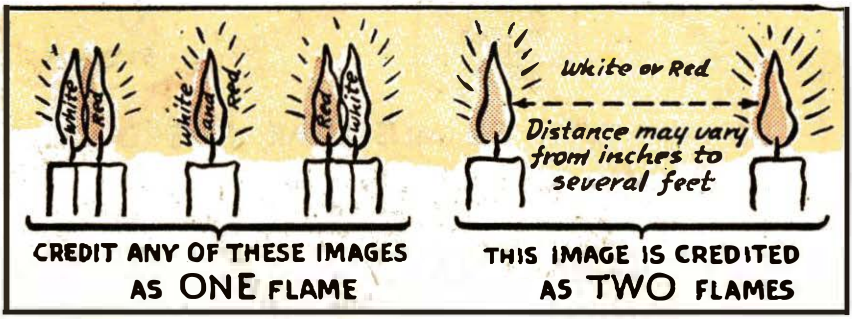


DETERMINING YOUR SIGHTING EYE



then tells the candidate to keep both eyes open and watch the candle flame. The helper then holds a disc of red cellophane directly over the candidate's non-sighting eye.

If the candidate sees two separate flames, one red and one white, then his ocular muscle balance is defective. Such a defect will disqualify him as a pilot in the armed services.

BALANCE TEST

Another of the twelve tests provided by Dr. Ray and Stanley Washburn is the balance test. The candidate removes his shoes and is blindfolded. The helper holds a watch with a second-hand. The helper tells the candidate to stand erect with heels together. The candidate is then told to raise his left foot off the floor and hold it off the floor for 15 seconds. He may raise his arms, or move the leg he is standing on but he must not touch the floor with his other foot. The candidate is given three trials. He must balance himself without touching the floor in at least one of these three chances. Then the test is repeated with the other leg raised.

CIRCULATORY EFFICIENCY

No special set-up is required for this test. The candidate must recline on a couch quietly for five minutes. The helper then counts his pulse, being careful not to exert too much pressure on the wrist while he is counting. The count may be taken for 15 seconds and multiplied by four. The count that is taken at this time is called the reclining pulse rate.

The candidate is then told to stand quietly for two minutes without resting against anything. At the end of this period his pulse is again counted, and recorded as the standing pulse rate.

The increase of pulse upon standing is recorded as the difference between the above two rates.

The next pulse rate to be taken is after exercise.

The helper places a chair in the center of the room, away from walls and furniture. The candidate then steps up on chair with one foot, allowing the other foot to hang alongside the chair. In the next 15 seconds he steps down on the floor and then back up on the chair a total of five times. He shifts his weight from foot to foot, one foot and his weight going down on the floor and then his other foot and his weight raising him to standing position on the chair. The last time he brings both feet down on the floor and stands quietly

while the helper counts his pulse. This is the after-exercise rate.

After the exercise, the helper continues to take the candidate's pulse at 15-second intervals to determine the length of time required for the candidate's pulse

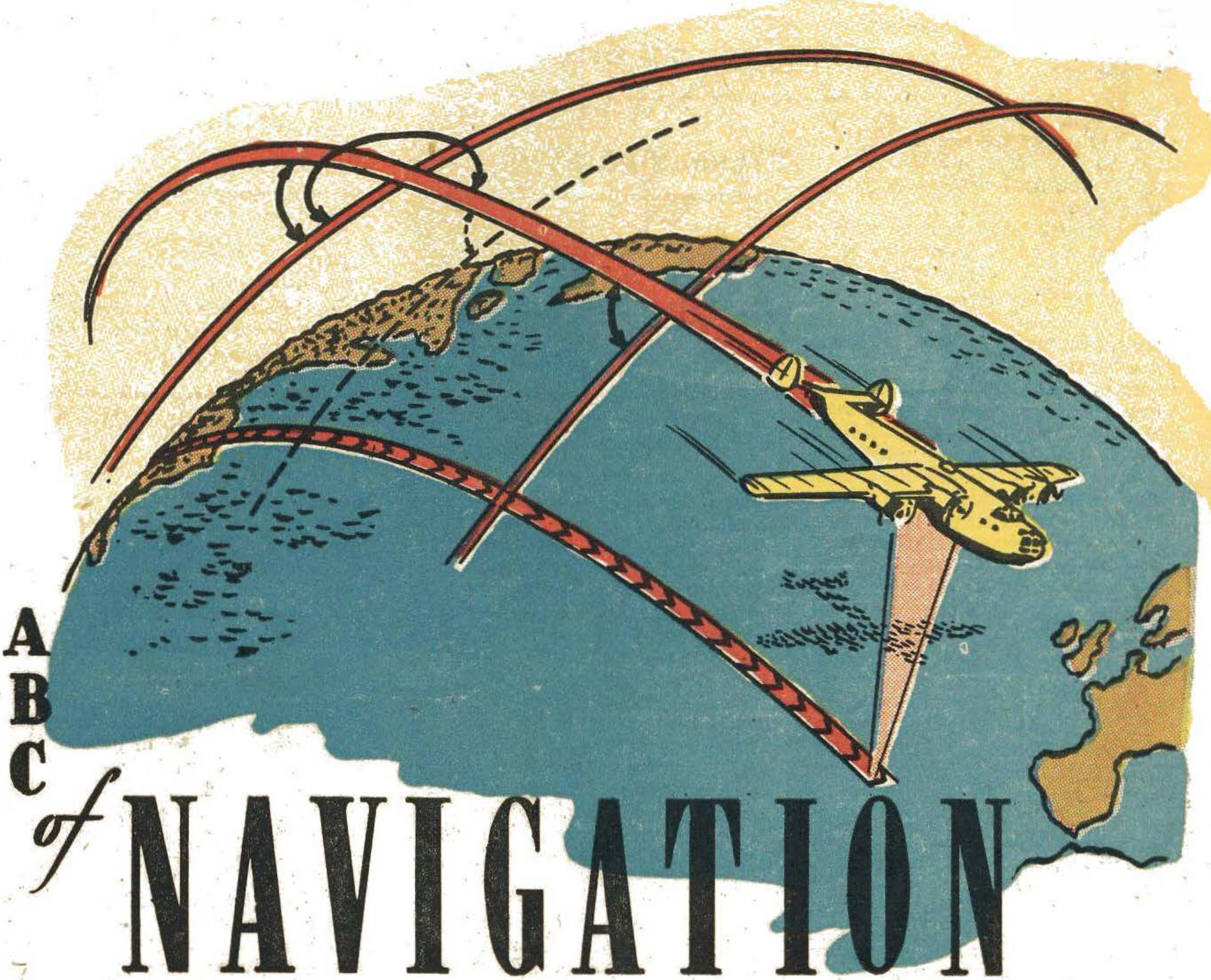
to return to the normal standing pulse rate previously recorded. The time is recorded in seconds.

By reference now to the grading given below a score for the candidate can be obtained. The Army and Navy require a score of six or more in a similar examination. To obtain the score, add the plus figures and deduct the minus ones.

RETURN OF PULSE AFTER EXERCISE	
0 to 30 seconds	Score 3
31 to 60 seconds	Score 2
61 to 90 seconds	Score 1
91 to 120 seconds	Score 0

RECLINING PULSE RATE		RATE OF INCREASE ON STANDING			
		0 to 10 Beats	11 to 18 Beats	19 to 26 Beats	27 to 34 Beats
Count	Score	Score	Score	Score	Score
50 to 60	3	3	3	2	1
61 to 70	3	3	2	1	0
71 to 80	2	3	2	0	−1
81 to 90	1	2	1	−1	−2
91 to 100	0	1	0	−2	−3
101 to 110	−1	0	−1	−3	−3

STANDING PULSE RATE		RATE OF INCREASE AFTER EXERCISE			
		0 to 10 Beats	11 to 20 Beats	21 to 30 Beats	31 to 40 Beats
Count	Score	Score	Score	Score	Score
60 to 70	3	3	3	2	1
71 to 80	3	3	2	1	0
81 to 90	2	3	2	1	0
91 to 100	1	2	1	0	−1
101 to 110	1	1	0	−1	−2
111 to 120	0	1	−1	−2	−3
121 to 130	0	0	−2	−3	−3
131 to 140	−1	0	−3	−3	−3



A B C *of* NAVIGATION

NAVIGATION is the science which enables us to determine where we are, and how to get from there to where we want to go. Factors involved in navigation are position, bearing, distance and time.

In order to identify positions, we cover the face of the Earth with a graph. The lines of the graph run North and South and East and West. All of the lines describe circles, as they form rings around the Earth. The lines that run East and West are parallel. All of the lines that run North and South are parallel to the axis of the Earth but are not parallel to each other as they converge at both poles. The North-South lines are Meridians of Longitude. The East-West lines are Parallels of Latitude.

The imaginary line which rings the Earth half-way between the North pole and the South pole is the E uator. From the Equator to the North pole is a quarter of a circle or 90 degrees. The North-South position of any point can be identified by its degree of latitude North or South of the Equator.

We arbitrarily establish Greenwich, London, as the reference point for East-West positions or longitude. A position, then, is described as being a certain number of degrees East or West of Greenwich and a certain number of degrees North or South of the Equator. For greater accuracy, each degree is divided into 60 minutes and each minute into 60 seconds.

The rotation of the Earth and the presence of the Sun give us our references for time. We call the time it takes the Earth to make one complete rotation a day. The Sun is the point of reference we use to determine when the Earth has made one complete rotation. The time of the day when the Sun is directly overhead is Noon. The period between one Noon and the next we divide into 24 parts or hours. For greater accuracy, we divide each hour into 60 minutes and each minute into 60 seconds.

As the Earth rotates from West to East, from a fixed position on the Earth, the Sun describes an East to West path across the sky.

Half of the Earth is always exposed to the Sun and the other half hidden from it. When it is daytime on one side of the Earth it is night on the opposite side.

The Sun is always directly above some North-South line on the Earth. We rotate under it at a rate of one degree (or about 69 miles) every four minutes. When it is Noon where we stand, as determined by the Sun, it is not quite Noon a mile or two to the West of us and it is a bit past Noon a mile or two to the East of us. But keeping time strictly according to the Sun in this way is not practical, so we

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establish time zones. As there are 24 hours in the day, we make 24 time zones.

When it is Noon where we stand, it is, according to this system, 11 A.M. in the first time zone to the West of us, and 1 P.M. in the first time zone to the East of us.

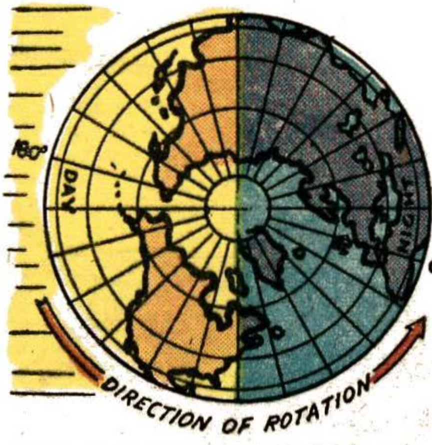
The time of day in each of the 24 time zones is known as Z.T. In navigation, Greenwich time frequently is used. Greenwich time is called G.C.T. Eastern standard time is in the fifth time zone West of Greenwich, so E.S.T. is five hours behind G.C.T. In other words, when it is 8 P.M. G.C.T. it is only 3 P.M. E.S.T., only 2 P.M. Central standard time, only 1 P.M. Mountain standard time and only Noon Pacific standard time. If you are in the sixth time zone West of Greenwich, add six hours to the time your clock says, then subtract an hour for war time or daylight saving time and the result will be G.C.T. War time is a temporary expediency to get us up earlier in the morning.

To delineate our time zones, we return again to Greenwich, London. Running through Greenwich, London, is the prime or zero meridian. At a point seven and one-half degrees of longitude on either side of the prime meridian we place a line running from the North pole to the South pole. We decree that when it is Noon in Greenwich it is Noon at every other place on the globe within seven and one-half degrees of the prime meridian.

We extend more of these lines from the North pole to the South pole, at intervals of 15 degrees of longitude, until the entire Earth is divided into 24 of them.

For local economic or political reasons it is necessary that here and there we make slight adjustments in the outlines of our time zones. If the time-zone line falls near the boundary of a state, we push it over a bit so that we can include the entire state in the same time zone. If the line cuts a small island in half, we put the whole island in one time zone or the other.

In order to give each hour of the day a designation for identification, we number it. We begin at Noon and the first hour after Noon is 1 P.M. or post meridian. We continue to number each hour after Noon as 2 P.M., 3 P.M. or 4 P.M. up until 12 o'clock midnight. After 12, the Sun is nearer to us from the East than from the West, so we start our numbering over again, designating the first hour after 12 M as 1 A.M. or ante meridian.



ROTATION CAUSES DAY AND NIGHT

In connection with time, the word meridian means the instant the Sun has reached the highest point in our sky (which is Noon.) Post meridian means after meridian. Ante meridian means before meridian.

In order to simplify time calculations, the Navy and Army Air Force count their hours of the day from one to 24 and eliminate A.M. and P.M. Four numerals are used for hours and minutes. 8:15 A.M. becomes simply 0815. 4:10 P.M. becomes 1610.

Directly opposite the Greenwich meridian, on the 180th meridian, we establish the International Date Line. The date line cuts down through Siberia and Alaska and between Hawaii and Australia. When it is Tuesday to the East of this line, it is Wednesday to the West of it.

The third factor involved in navigation is distance. A lot of methods are used for measuring distance. The one most common in navigation is based upon the circumference of the Earth, our 360 degrees of longitude at the Equator and our subdivision of 60 minutes to each degree. We compute the distance involved in one degree of longitude at the Equator and divide it into 60 parts, representing one minute of degree of longitude. This distance is called a nautical mile. A nautical mile is 6080.2 feet. A statute mile, or common land mile is 5280 feet.

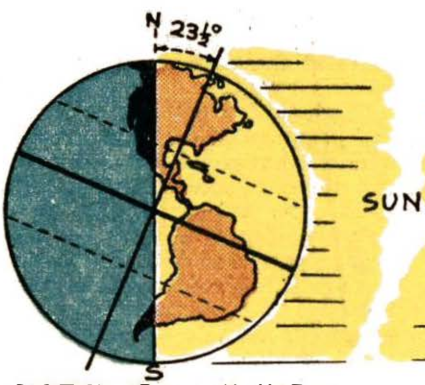
If you know the distance between two points in nautical miles and would like to know what the distance is in statute, or common land miles, multiply the number of nautical miles by 1.152. If you want to convert statute into nautical miles, divide the number of statute miles by 1.152 and the result will give you nautical miles. This formula is sufficiently accurate for all practical purposes.

A degree of longitude at the Equator consists of 60 nautical miles or about 69.12 statute, or common land miles. The Earth is not a perfect sphere. The equatorial circumference usually is considered to be 24,902 statute miles and the meridial circumference 24,860 statute miles.

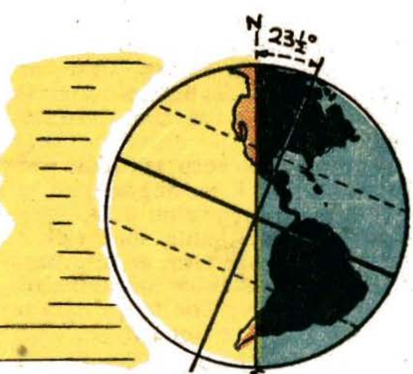
When we determine where we are and where we want to go, in terms of latitude and longitude, it is necessary to establish the bearing of our destination.

The shortest course between two points on the globe is the line that would be obtained if a string were stretched tightly over the globe from one point to the other. If the strihg were continued on farther, without deviation, it would go on around the World and arrive back exactly at its starting point, and the World would be divided by the string into two equal parts. Any circle around the Earth which divides it into two equal parts is called a great circle. The Equator, for instance, is a great circle. All meridians are great circles. The shortest distance between any two points on the face of the Earth is part of a great circle.

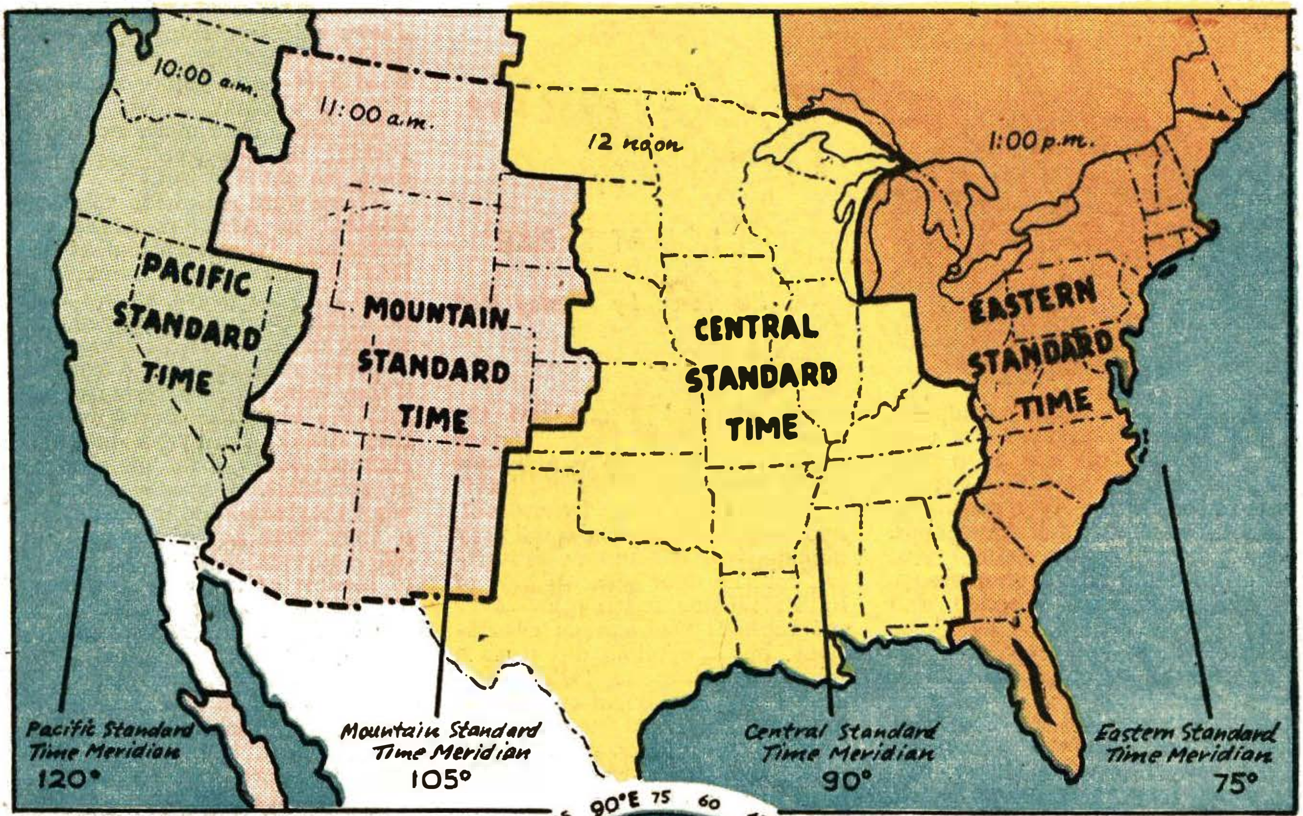
If the position of your destination is on the same meridian that you are on, the shortest route



POSITION OF EARTH JUNE 21



POSITION OF EARTH DECEMBER 21



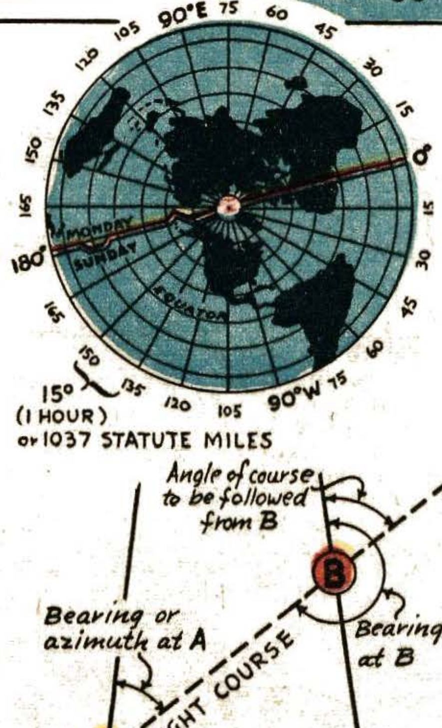
to your destination would be along the meridian. If you were standing at the Equator and you wanted to get to some other point on the Equator, the shortest route between the two points would be along the Equator. In either case, you would follow a great circle.

A bearing in navigation is the relation of one position to another position in reference to true North. A bearing is expressed in terms of the angle it makes with true North. The angle from true North is measured clock-wise. The bearing of a position due East of you would be 90 degrees; if due South, the bearing would be 180 degrees; if due West the bearing would be 270 degrees.

Our meridians give us our true North. The relationship of one position to another can be defined by the manner in which they bear on the meridians.

The meridians are, of course, only imaginary lines until they are reduced to a map, chart or globe. And this brings us now to the subject of the aviation chart or map.

There is no accurate chart of the World. It is impossible to reproduce a sphere on a flat surface without having to make a sacrifice in one way or another. There are a number of different types of maps. The three which are used most frequently in aviation are called the Mercator Projection, the Gnomonic Projection



Note—Meridians are not parallel.

and the Lambert Conformal.

The Mercator Projection shows meridians and parallels of latitude as straight lines at right angles to each other. The meridians are equally spaced. The distance between the parallels of latitude increases from the Equator as they approach the poles. Although quite accurate near the Equator, this chart is distorted toward the poles.

In the Gnomonic Projection, meridians are shown as straight lines which are converging. The parallels of latitude are curved lines. The Equator is a straight line. A great circle on the Gnomonic chart is a straight line.

On a Lambert Conformal Projection, the parallels of latitude are arcs of concentric circles. The meridians are straight lines which converge at a common point. The point at which the meridians converge is also the center of the concentric circle arcs, representing the parallels of latitude. The advantage of the Lambert Conformal Projection is that the meridians and the parallels of latitude correctly form right angles at their intersections. A straight line on this chart is, approximately, the shortest distance between two points.

In the next iss e of Flying Cadet will be pictures of these three types of charts and diagrams which will explain how they are used.

The Honor AND THE GLORY..

By

ROBERT S. PIKE

Illustrated by Wesley Neff

"WAKE up, Jack!" Andrews, the good-natured, fat proprietor of the Ship and Bottle pub, situated just beyond the bounds of the Avon airdrome, kicked gently at his roustabout, or "porter" as he called him, and repeated his exhortations.

The little man groaned and rolled over. Shakily he drew himself erect and tried to focus his eyes on his employer. Those eyes were black and large, mirroring sickness and self-contempt and an infinite, bitter weariness. Just now they were bleary, too, and the adipose Andrews shook his white apron impatiently.

"Wake up, man! Empty those cuspidors, and sweep out the place. I expect those Yankee Eagles will be in here any time now. They haunt the old pub!"

He chuckled at his fancied wit, and Jack, fingering his small gray moustache uncertainly, was starting for the door when a pair of Spitfires came roaring low over the roof. It was against regulations, but the pilots did it as a joking greeting to "Old" Andrews, and so far no complaints had been made. At the deafening blast of the motors, Jack turned pale. His hands went over his head in fear, and he shrank back into the chamber.

"You're a funny beggar," Andrews said, watching him curiously. "Twenty-two years you've been here—and you're scared to death of planes."

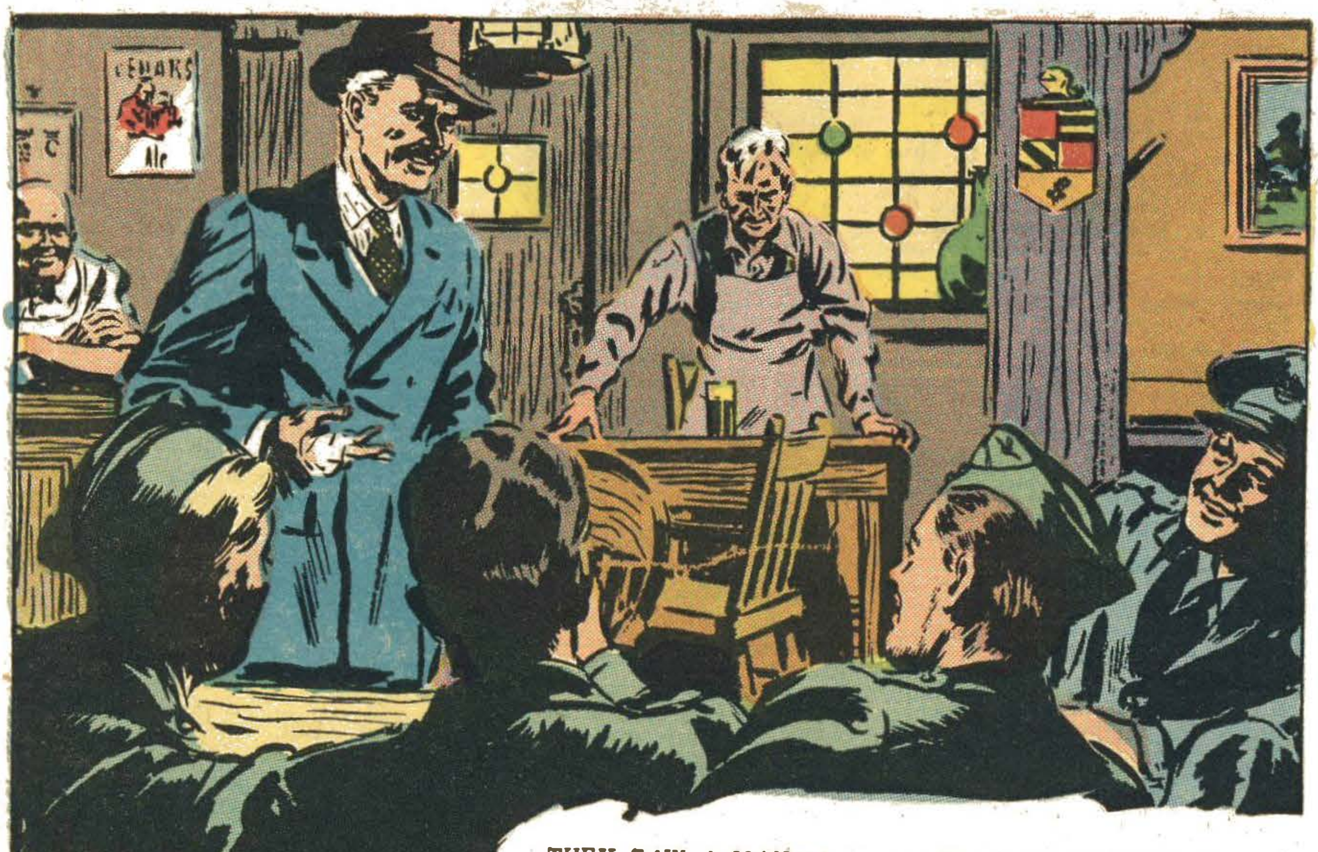
The little man made no reply. Picking up a besom beside the door, he shuffled out.

There were six of the "Yankee Eagles," as Andrews called the American flyers attached to the RAF unit stationed at Avon. They were all youngsters, as yet with no actual combat experience, but raring to go.

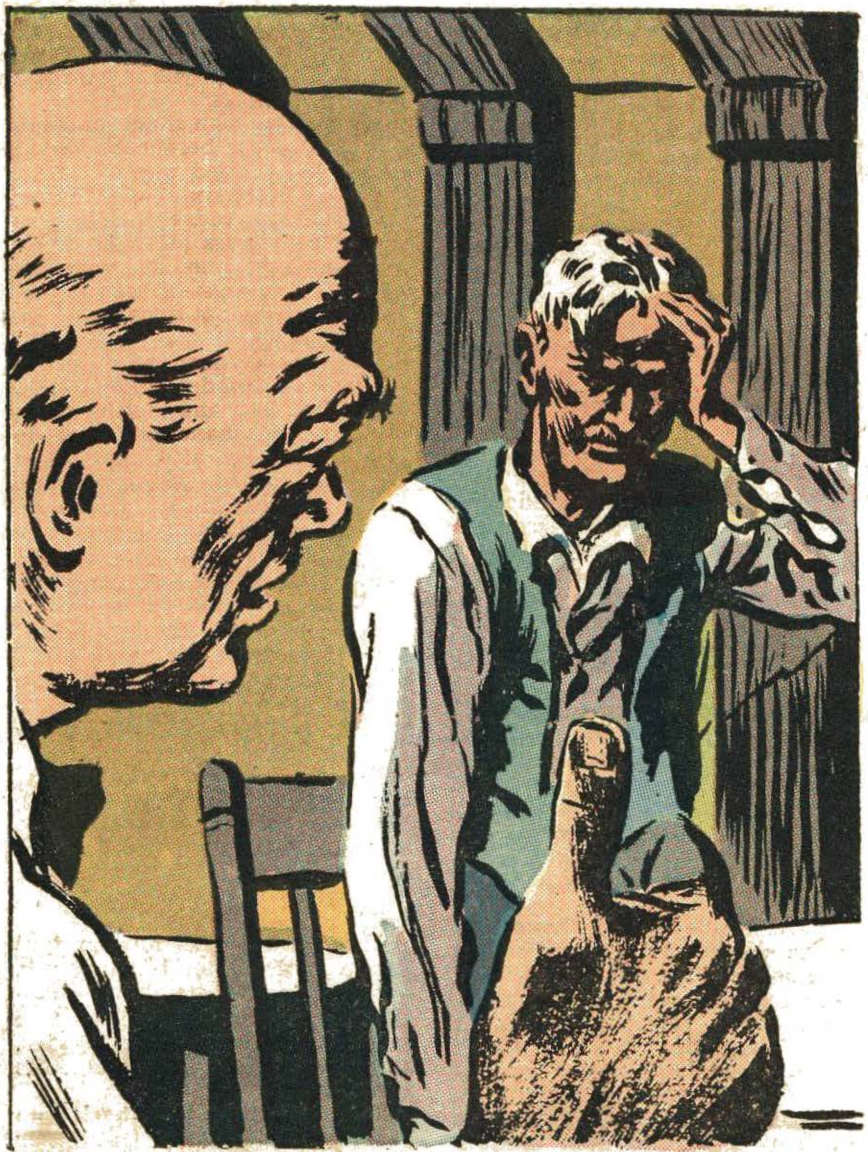
Every afternoon at 4 o'clock, if they were off duty, they trooped into the Ship and Bottle, where they drank shandygaff and declaimed loudly, after the manner of red-blooded young men, of what they would do to the Jerries if they ever got a chance. Fat old Andrews, who had a couple of medals of his own gathering dust on the parlor wall back of the bar, had a soft spot in his heart for them.

This day, as they sat and quaffed and lied and laughed in their heroic fashion, there came into the low, blackbeamed taproom two men, one in uniform, the other in mufti.

"Flight Commander Nicholson," murmured one of the



THEY SAW A MAN who was tall, narrow and quick of movement. When he grinned, the boys instinctively warmed to him.



SHAKILY, THE LITTLE MAN drew himself erect. His eyes were black and large, mirroring self-contempt and infinite, bitter weariness.

Eagles, noting the uniform. "Attention!" he bawled. Nicholson called a cheery "At ease!" and they relaxed, grinning. The officer looked at each of them in turn.

"Men," he said, in a clipped, precise English, "this gentleman with me is Long John Horton, one of your countrymen. I have known him for many years. He was, I may say, the hero of my boyhood."

Commander Nicholson's prowess in the air was legendary in the RAF. The idea that any man could be a hero to *him* made the young Eagles sit up and regard the stranger more carefully.

They saw a man tall and narrow, quick of movement, with long arms and long-fingered, fine hands. The black hair on his long head was scanty, and he wore a close-cropped moustache streaked with gray. His small blue eyes were piercing. He grinned at the boys, and instinctively they warmed to him.

"Have a glass of ale with us, sir," one of them offered, and banged on the table for service. The roustabout Jack, clad in a fresh apron, brought the order. He put the glass in Horton's outstretched hand and stood looking at it with unmistakable longing on his dark, hollow-cheeked face.

Long John Horton saw it, and laughed as he flipped him a coin. "Keep the ch—" he said. He did not finish the sentence. Instead, his fingers tightened around the tumbler so convulsively that the glass shattered in his hand. Blood from his cut fingers mingled with the ale and dripped unheeded on the sanded floor. His sharp eyes stabbed like twin daggers at the thin, shabby porter, and he repeated, mechanically, slowly, "Keep—the—change."

The old man stared back at him bitterly, weariness and self-contempt plain in his eyes, but he spoke no word.

Horton swung on his heel to face the table of Eagles. "Sorry I was so awkward," he said apologetically, wrapping his hand in his handkerchief. "Let me stand a round for all of you." He called across to Andrews back of the bar, and the proprietor himself brought over the drinks.

Nicholson waved aside an offer to join them. "Mr. Horton," he told the Eagles, in his quick, precise manner, "was a captain in the Escadrille Lafayette, the most famous section of the most famous group of flyers in the last World War. Perhaps," he added, "the most famous group there ever will be, for those men went forth like knights of old, to do battle in crazy crates that you and I wouldn't dare to climb into today.

"Captain Horton is here on a government mission, and he looked me up. I thought it would be agreeable to you young Americans if he would say a few words to you in your—ah—own language."

He smiled, and the Eagles grinned. A great guy, Nicholson. He might talk like a bally schoolteacher, but the record of his deeds showed that he was all man.

"I've got to shove off now," the officer said. "See you in half an hour, John. Cheerio!"

The six Eagles were perched all in a row on a scarred oaken bench that ran along the wall. Long John Horton, ex-Captain in the Escadrille Lafayette, took a chair opposite them across the long table. From the corner of his eye he could see Andrews behind the bar, and Jack sipping a drink at a table near the door.

"You lads remind me of my own youthful days," he began. "Full of vim, vigor and vitality. Fire, energy, enthusiasm, a desire to fight and raise the roof in general. And afraid of nothing on the earth below nor in the sky above."

The boys nodded in proud seriousness. Horton smiled to himself. He knew he had them with him. But the half-formulated pep-talk Nicholson had asked him to give had gone entirely from his mind. He was thinking of days and of deeds long dead. Of a man long dead, but whom he had just seen with his own eyes.

CONTINUED ON NEXT PAGE

It wasn't possible, he told himself, and shook his long head in impatient bewilderment.

"When you get older," he went on, "you will lose that fire and dash. Your hair will get thin like mine, and your bellies fat like the barkeep's there. It's the law of life. I knew all the great airmen of the last war—and I know many of them yet—but like me they've grown old. We can't do the things we'd like to do, the things we used to do.

"I'd like to tell you about the greatest of them all. Being in the RAF, you've heard of Billy Bishop? And of course you know who Eddie Rickenbacker is. You may even have heard of von Richthofen. But what do you know of Guynemer?"

Six blank faces were his answer. The lean ex-Captain shrugged his strong, narrow shoulders.

"Such is fame," he said. "But lads, as long as a man of the Lafayette Flying Corps is left, as long as a Frenchman survives who was old enough to remember the War of 1914-18, the memory of Georges Guynemer will not die. For he was the greatest of them all. The Ace of Aces, the Winged Sword of France. We have our heroes today — the Campbells, the O'Hares, the Nicholsons, and a host of others —but there will never be another Guynemer!"

Another Spitfire came roaring low over the pub, and Horton, from the tail of his eye, saw the instinctive, frightened reaction of the man Jack, and with terrible suddenness many things became clear to him.

"In August, 1914," he took up his tale, "Guynemer was a frail boy, barely twenty years old—like most of you—and with the mark of the white death already plain on his face. Five times he tried to enlist, and five times the army doctors rejected him. Finally he got in as a laborer at the Pau training field.

"Three months later they had to give him his wings, and for two years and a half he blazed a trail of glory across the skies such as no man has ever equalled. Two, three, four, six German planes in one day he shot down from his one-seated old Nieuport and Spad. Such crazy crates as you laugh at in museums today, but they were no laughing matter then.

"Seven times he was shot down, and we didn't have parachutes in those days. Dying of consumption as he was, the man bore a charmed life. Once, with one wing ripped entirely off by a shell, he fell ten thousand feet, and the nose of his plane stuck so far in the ground it couldn't be budged. Guynemer stepped out and walked home without a scratch on him!

"He received every decoration the French Government could give, including the Rosette of the Legion of Honor. He was wounded twice, he escaped death by a hair's breadth innumerable times. Just to cite one, a bullet from an enemy plane penetrated the revolution counter in a direct line for his heart, but stopped after bulging out the brass toward him.

"Attack! Attack! Always attack! was Guynemer's motto. He would tackle twenty Boche planes as eagerly as he would go after one, and his fame spread among them until they let their army know in special bulletins whenever he shifted from one base to another along the front.

"Little good it did them. In January of 1917 he performed the most spectacular feat ever accomplished by an aviator in actual combat. He brought down and captured, without weapons of his own, an enemy two-seater carrying a pilot and a gunner. He drove them as a dog drives cattle, and they didn't dare to turn and fire at him!

"His name was a household word all over France, and among the soldiers he was a legend. If you found a poilu feeling glum, you could mention Guynemer and his exploits, and could fairly see courage and enthusiasm flooding back into the man. They knew that on his frail wings he bore a part of their dreams, of their faith in final victory, of all that their hearts held of confidence and of hope."

The ex-Captain's clear, penetrating voice filled the little taproom. From the corner of his eye he noted that Andrews behind the bar, and Jack at his table, were listening attentively. His voice dropped.

"To such," he said slowly, "is the honor and the glory that shine in all men's sight."

He glanced at his wrist-watch and shoved his chair back. "Got to go, boys. Good luck!"

One of the Eagles spoke: "But, sir—what became of Guynemer?"

The lean American stood up. "Nobody knows. He was reported missing in action in September, 1917. The Germans trumped up a cock-and-bull story about his death—but no man ever saw his body or his plane. And no German ever flew who could have killed Guynemer! All we know is that he didn't come back, and his plane was never found. The white death was hard upon him, and the French believe he went to sleep in his plane, up there ten thousand feet in the sky, and was carried straight to Heaven."

The man Jack was on his feet, looking at them, his hands gripping the edge of his square wooden table.

"He's going to tell them," Horton thought.

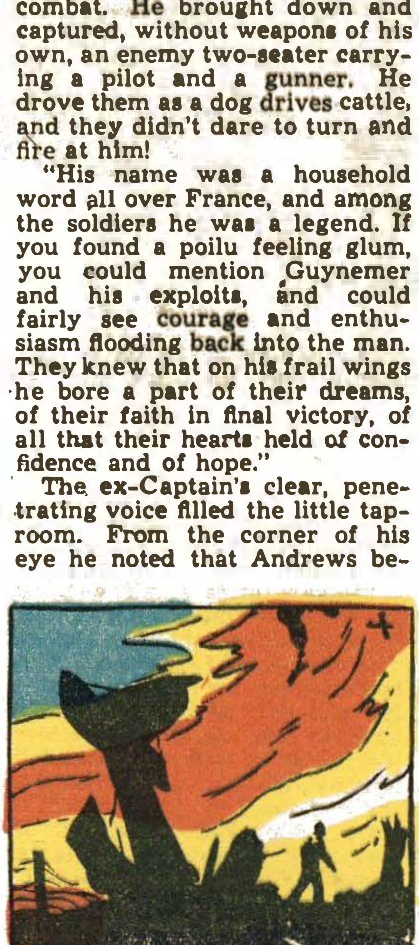
But the Eagle who had asked the question sprang to his feet, his eyes shining. "To such are the honor and the glory," he repeated, raising his glass. "To Guynemer, the greatest of them all!"

Horton, his eyes on the taut figure at the other table, drank, and hurled his glass into shattered fragments on the floor. The gesture was new to the Eagles, but they promptly followed his example.

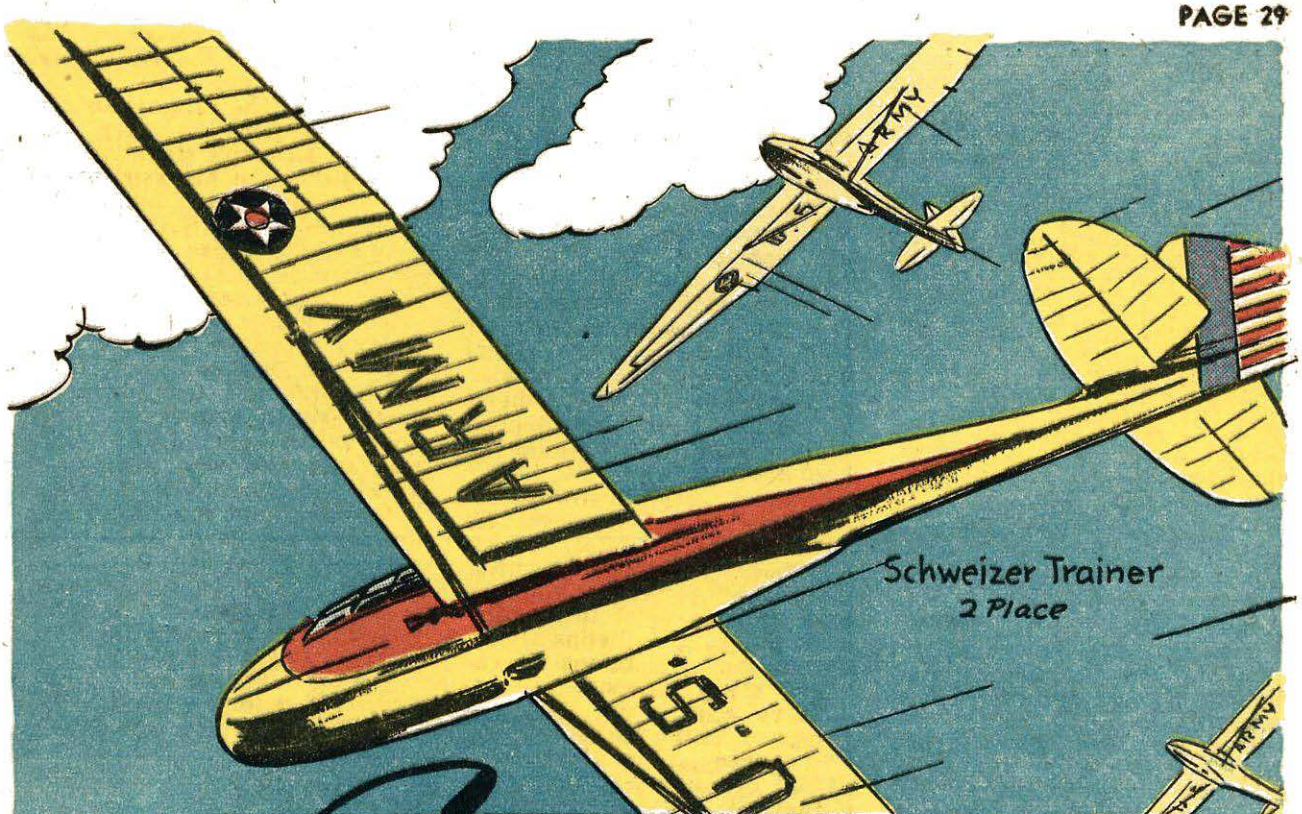
The man Jack sank back into his chair. He wasn't Guynemer any more. He was a bitter, fear-cracked, aging haunted thing, loving airplanes, but afraid to touch one after that last disastrous crack-up twenty-five years before.

But to these eager, bright-eyed boys, he was an ideal, a model, a hero, a shining mark at which to aim. He mustn't let them down. What would be the use, anyway, after all the dead, forgotten years? The little porter sank back in his chair and held himself stark and rigid while the Eagles passed him by, their usual noisy chatter stilled as they pondered Long John Horton's story.

And Horton knew, and the forgotten man at the table knew, that each one was determining in his heart that some day he should do more shining deeds even than those of Guynemer, the incomparable Ace of Aces, the greatest of them all.



HE DIDN'T return, but his body and his plane were never found.



Gliders

BY THE THOUSANDS!

By MAJOR LEWIN B. BARRINGER
Glider Specialist, U. S. Army Air Forces

THE glider is here to stay It will undoubtedly play an important role in winning the war and in winning the peace

The transportation of men and supplies from one point to another and the surprise attack on enemy positions by air-borne shock troops are the two principal military uses of the troop glider. The German glider trains which carry tons of material and hundreds of men from supply bases to advance positions, and the capture of key forts and important bridges by glider-borne troops during the blitz in Belgium are classic examples of the glider's utility in modern warfare.

But the glider is destined also to have far-reaching social and economic implications after the war is over I predict that shortly after victory is achieved we shall see huge glider trains carrying tons of cargo and thousands of passengers to all parts of the world at speeds well in excess of 200 miles per hour Such facilities will go a long way toward relieving economic pressure and promoting intelligent cultural relations throughout the world

The U S. Army Air Forces Glider Program is well under way. The very nature of the war requires the maintenance of supply lines to far-flung battle fronts We must lift our cargoes into the air—out of reach of the prowling submarines and surface raiders. Efficiency is of paramount importance. Aerial transportation through the use of gliders is the answer The gliders are coming by the thousands!

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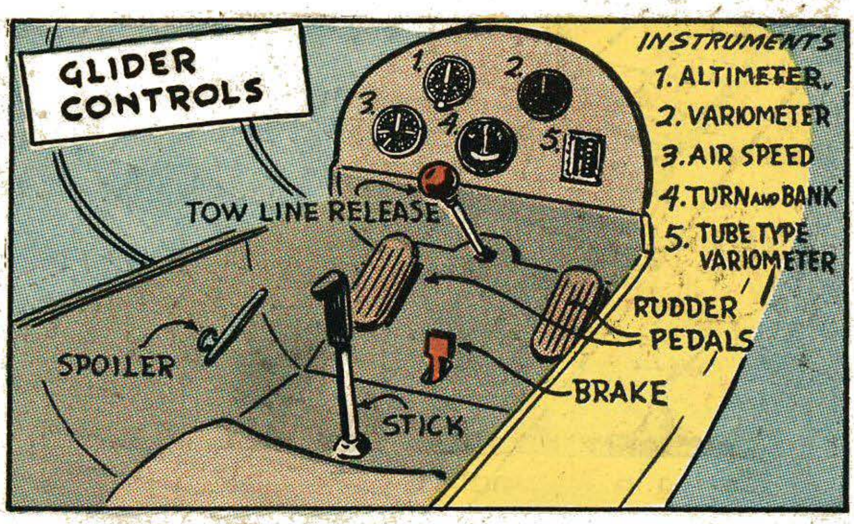
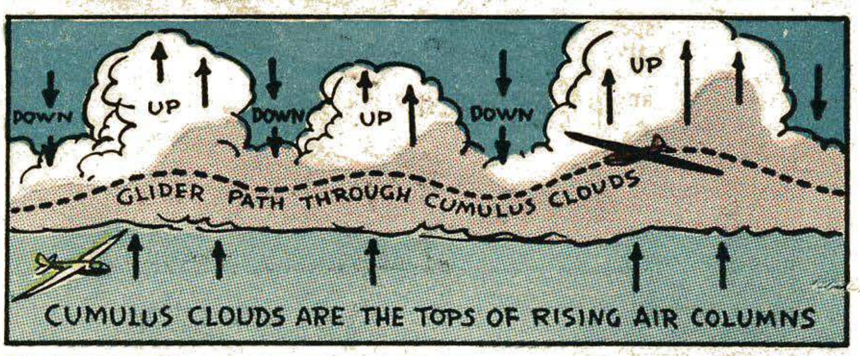
Twentynine Palms is no longer a sleepy little desert town in the southern part of California. It has become a haven for Army Air Forces pilots who are learning to fly without motors.

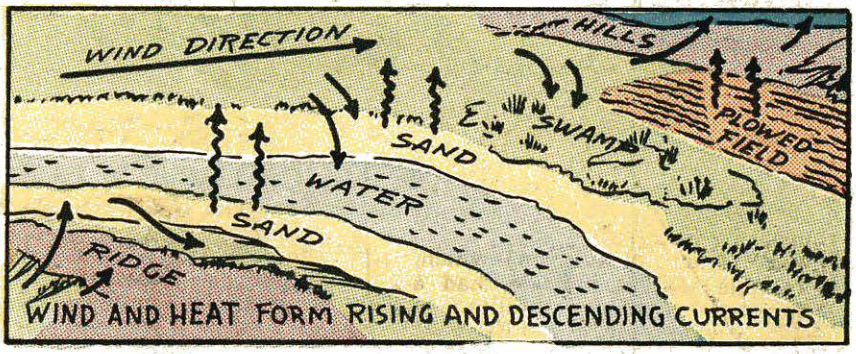
At the beginning of this war there were only a few hundred glider pilots in the United States and glider production was a stubborn bottleneck. Compared to Germany, Russia, and other European countries, the United States has been slow to accept gliding as a sport and to recognize its military importance. However, the picture is changing. A glider pilot training program has been put into operation under the Flying Training Command and the master woodcraftsmen of our piano and furniture industries are manufacturing military gliders on a mass-production basis.

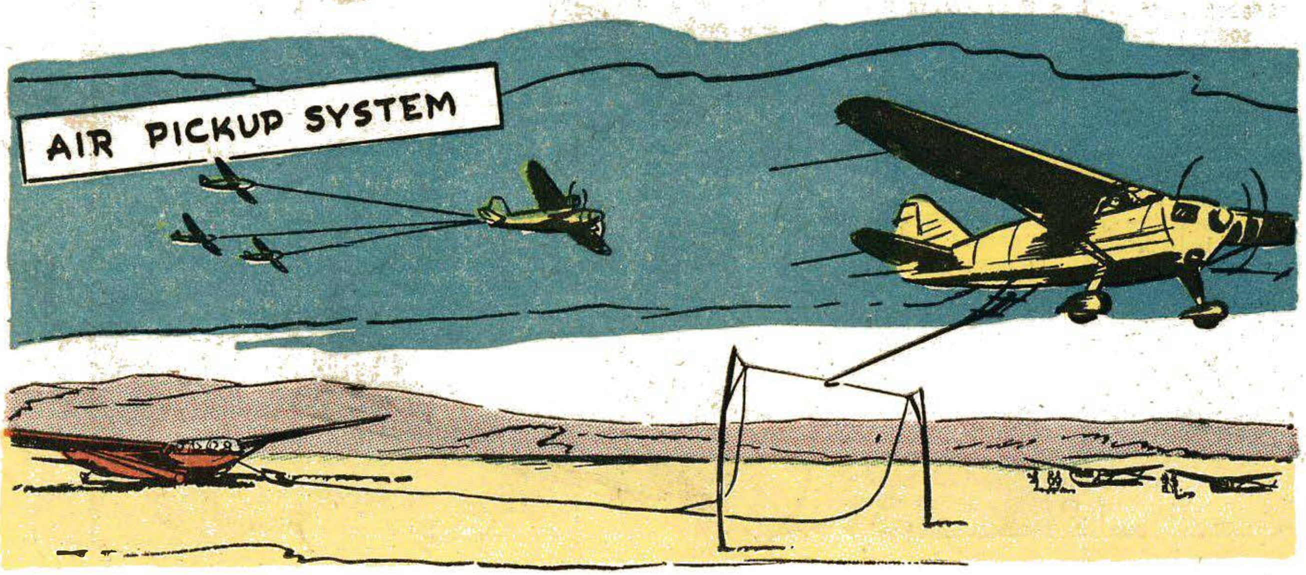
It is ironic that certain stipulations in the Versailles Treaty limiting the use of power-driven aircraft gave impetus to the widespread use of gliders in Germany. Glider clubs with their frequent contests mushroomed throughout the country. Treaty limitations were circumvented and the desire to fly was satisfied through the use of powerless aircraft.

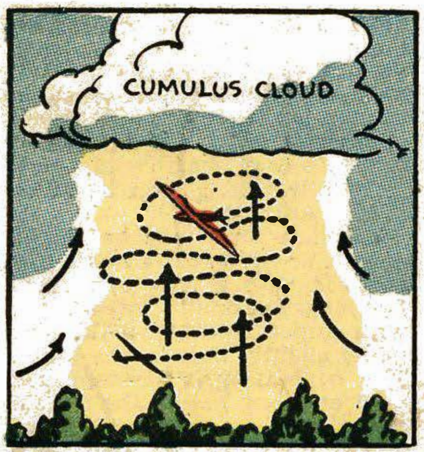
When the Nazis came to power in 1933, the glider clubs were subsidized by the government and large gliding centers were organized. Field Marshal Hermann Goering and other German militarists were wide awake to the value of glider pilot training as a means of building flying personnel for a powerful air force. New schools were set up where both girls and boys learned to build and fly gliders. The Nazi



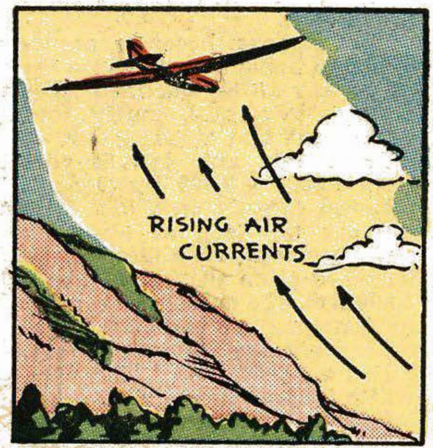




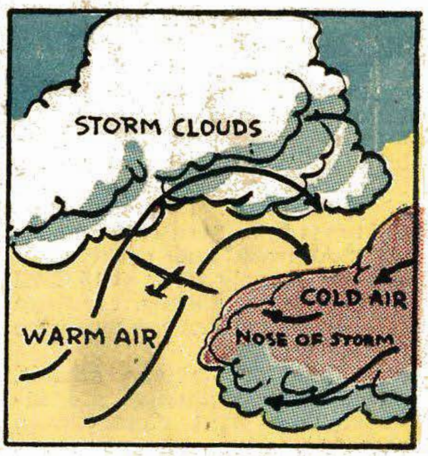




Soaring in Thermal Lift...



Slope Lift...



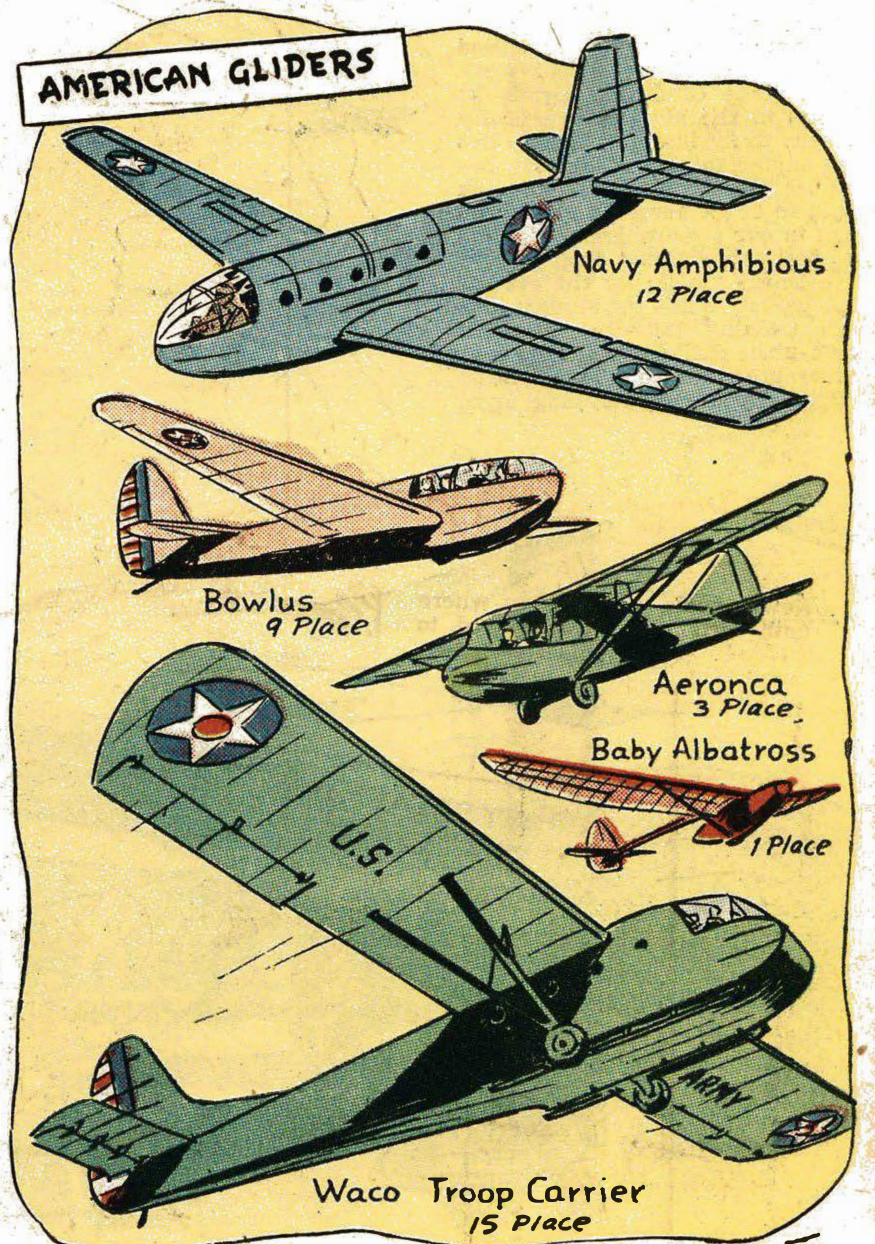
Cold Front

government, sponsoring contests, offered attractive prizes to the winners.

By 1940 approximately five million German youth had received glider training, and out of this tremendous reservoir came 180,000 expert airplane pilots and 220,000 mechanics who have formed the backbone of the powerful Luftwaffe. It is now reported that all German youth who can meet basic physical requirements must take an elementary glider course designed to weed out the boys who, because of mental, psychological, or physical deficiencies, are not capable of becoming pilots.

Gliding developed even more rapidly in Russia where since 1922, the Russian Government has generously subsidized the movement. The Russians organized a society called the "Aviakin" (friend of aviation) which, reliable sources indicate, had a membership of four million in 1926. It is understood that each member paid the equivalent of $9 each year as dues, thus giving the society's treasury an income of 36 million dollars yearly. The millions of dollars collected by this semi-official organization, together with Government funds, were used to build airports and hangars, design and build experimental ships, and to carry out exhaustive research in the use of parachutes.

No doubt it is due to the outstanding achievements of the Aviakin that Russia holds several of the most important glider records, was the first nation to recognize the practical value of towing gliders behind transport planes, and by conservative estimate had more than 600,000 expert male and female glider pilots in 1941. It is no wonder that Russia has a seemingly inexhaustible supply of expert flyers.



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To return to that ancient dry lake at Twentynine Palms. The hot sun there bakes the earth the year around, producing many thermals (rising air currents), which lift the soaring planes to high altitures, providing excellent conditions for glider training. But in order to train thousands of glider pilots, additional gliding bases have been organized in the Southwest and preliminary training is being given at 18 Civil Aeronautics Administration schools located principally in the Middle West.

At the preliminary schools, glider pilot candidates are instructed in light motor-driven airplanes, with emphasis being placed on "dead stick" landings to familiarize students with one of the more difficult features of glider piloting. The preliminary course lasts four weeks.

Advanced training is filled with thrills. During a four-week course, the candidate spends 30 hours in the air and practically learns to fly like a bird. He has no engine to rely upon. He becomes sensitive to the complex system of air currents ever present in our atmosphere. He learns to feel the slightest drop or rise. He learns "to fly by the seat of his pants"! While the student gets his training initially on small two-place gliders, he spends considerable time on large cargo types capable of carrying eight or more men with sizable loads of material.

The student becomes accustomed to being launched into the air by any of the four methods—straight auto pull, pulley tow, winch tow, and airplane tow.

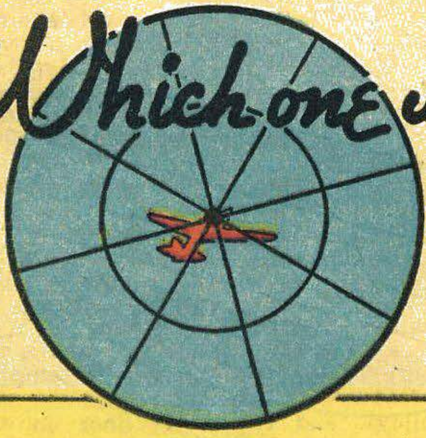
In straight auto tow, a wire from 1,500 to 3,000 feet long is fastened directly on a car. With the car traveling at about 47 miles per hour, the glider may be launched at an altitude of nearly 1,500 feet. The pulley tow is made by fastening one end of the wire to a stationary concrete block, called a "dead man." The wire, which is approximately 4,500 feet long, runs through a large pulley fastened on the back of the tow truck. With this device the truck travels from 7 to 23 miles per hour in low gear, depending on the wind, and permits launchings up to 2,400 feet. On the other hand, the winch tow is executed from a stationary motor-driven winch; by using about 6,000 to 7,000 feet of steel wire, very smooth launchings can be made at high altitudes.

Airplane tows may be single, double, or triple. The single tow is made with a rope about 300 feet long. The double tow is made with ropes forming a Y, one glider slightly back of the other. The triple tow is accomplished with one long line in the middle and two short lines on either side. With proper piloting a towplane, powered with only a 295-horsepower engine, can easily take off with three gliders.

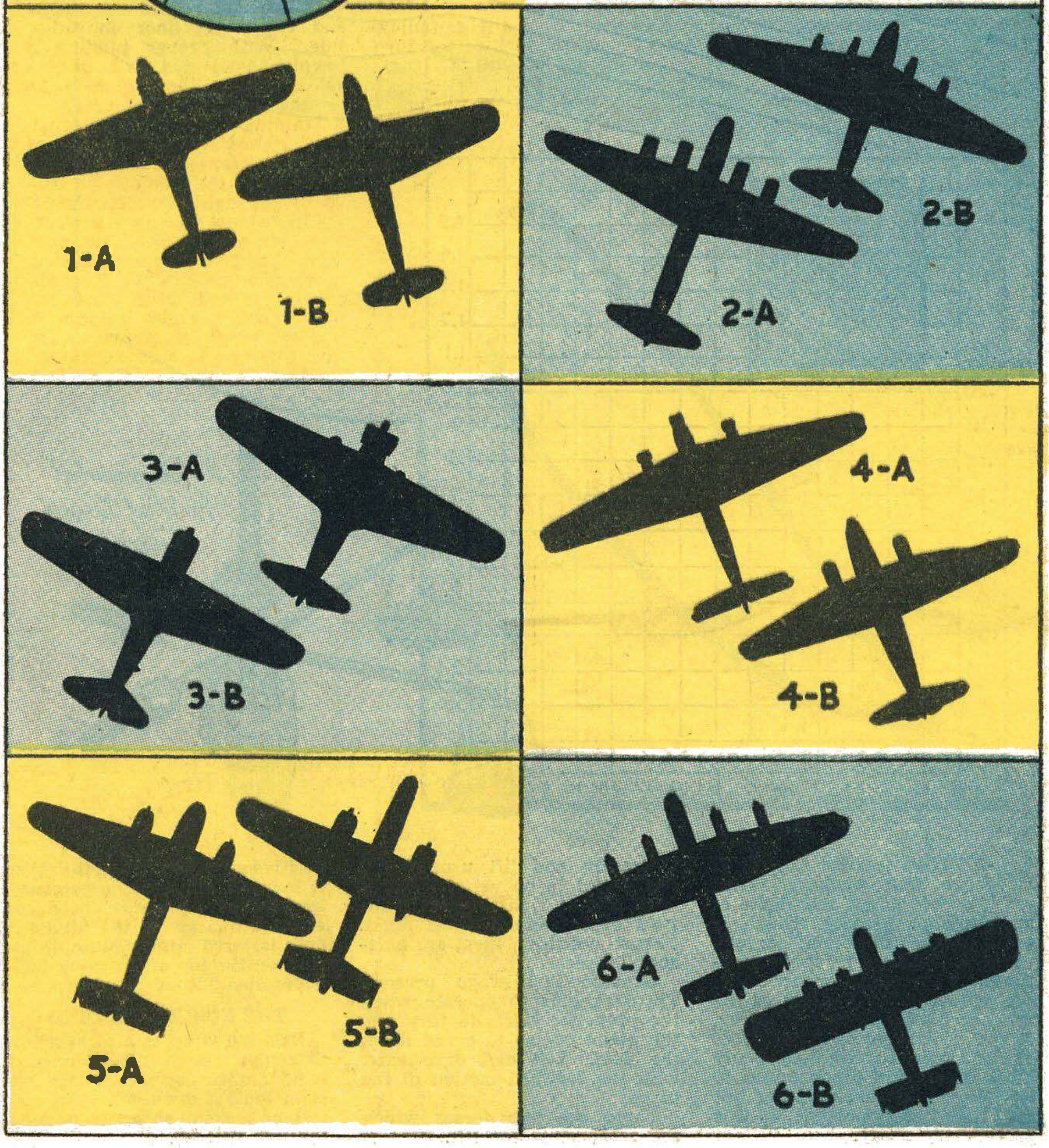
Training operations at Twentynine Palms involve flights of various distances and durations. Because of the number of students long flights are discouraged.

All students who have successfully completed the glider pilot course are given the aeronautical rating of a glider pilot. They are entitled to wear pilot wings inscribed with a glider insignia. A selected group of graduates are commissioned as second lieutenants, with pay up to $245 a month. Other graduates are given the grade of staff sergeant and receive flying pay amounting to $144 a month.

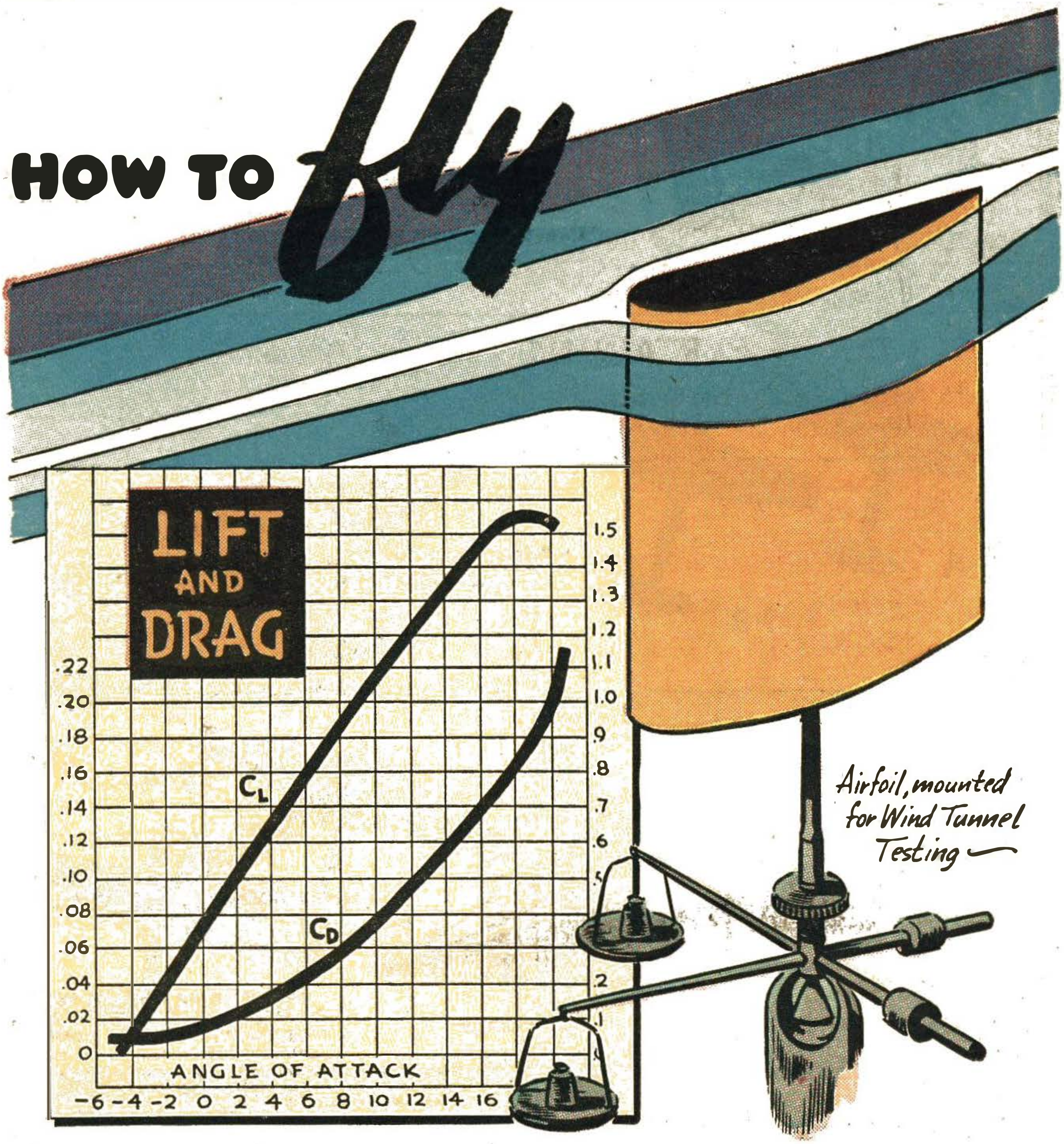
Which one would *you* shoot at?



A REMARKABLE resemblance between the outline appearance of certain airplanes makes it difficult to distinguish some Allied and Axis ships. Yet, there are minor differences that can be detected. Can you spot them? Each panel on this page contains one Allied and one Axis plane. Which is which? Correct answers will be found on Page 58.



HOW TO fly



WE have learned that there are four primary forces which affect the flight of an airplane: gravity, which is constant in direction; thrust, which is produced by the engine-powered propeller or airscrew; lift, which is the product of the wing in the airstream; and drag, or the resistances of the surfaces of the airplane to motion of any kind. There are other forces to be taken into consideration but they are not important in this preliminary study.

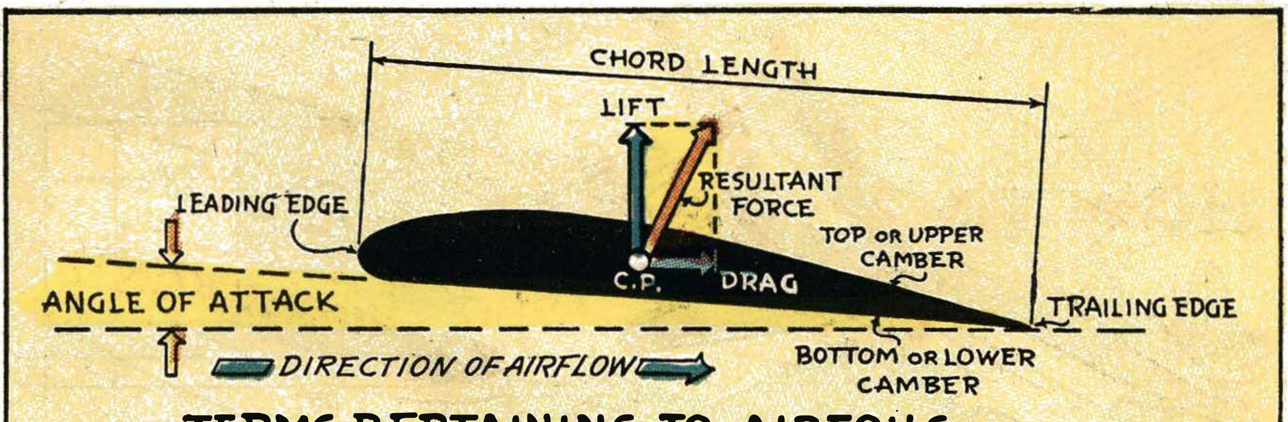
Gravity and lift usually are considered to be vertical forces, operating at right angles to the path of a plane in level flight. Thrust and drag, then, are horizontal forces.

Gravity is always present. Thrust begins to operate when the propeller starts to turn and the plane begins to crawl down the field. Lift and drag exist with the forward motion of the plane.

There are two forces which are responsible for lift. One is positive air pressure and the other is lowered atmospheric pressure. Positive air pressure produces about a quarter of the total lift and lowered atmospheric pressure on the top of the wing produces about three-quarters.

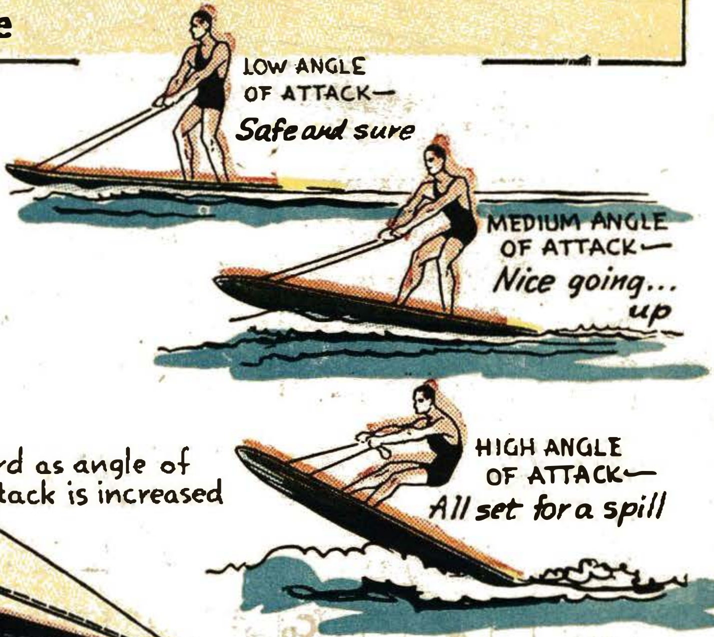
THE FORCES OF WIND

Relative wind is a term given to air in motion. The forces of wind are the same whether air is in motion against a solid object or a solid object is passing through still air.



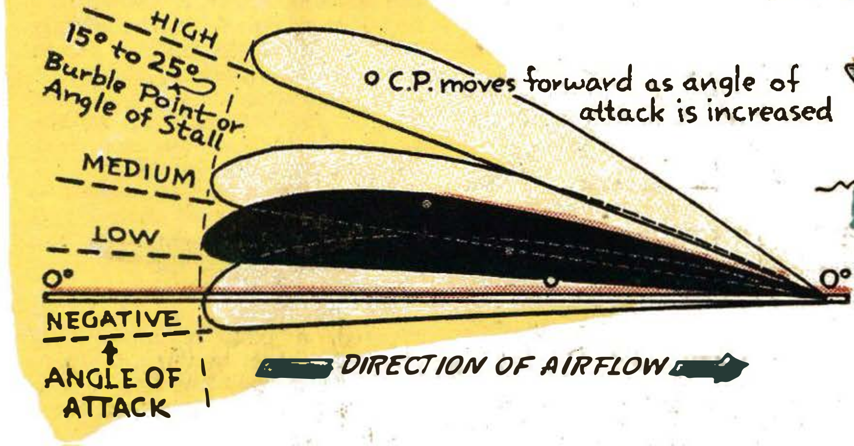
TERMS PERTAINING TO AIRFOILS

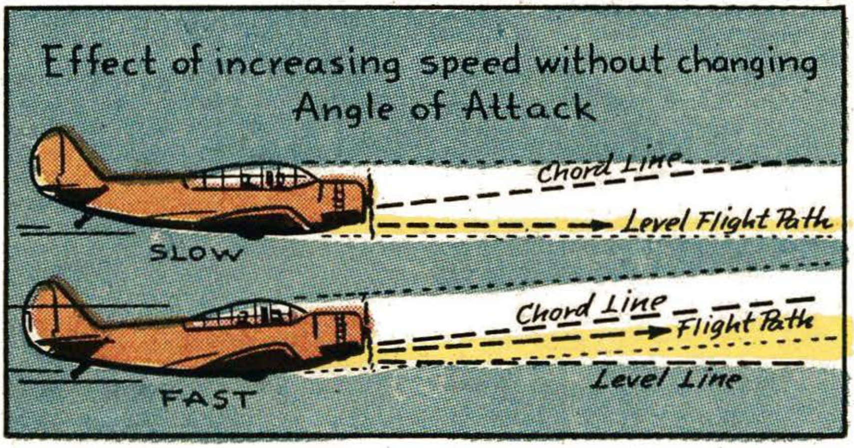
Lift forces concentrate and act together at Center of Pressure



Lift depends on—

1. RELATIVE WIND OR SPEED
2. ATMOSPHERIC PRESSURE
3. DESIGN AND AREA OF WING
4. ANGLE OF ATTACK





Relative wind operates against the bottom surface of the wing to produce positive air pressure. The direction of the force is upward and backward. That portion of the force which is pushing the wing upward is developing direct air-pressure lift. The portion that is backward in direction is producing wing drag.

AIR PRESSURE LIFT

The second force which is responsible for lift is atmospheric pressure. Air, as we all know, exerts an outward pressure that is equal in all directions. When air is moving past at a rapid speed it does, however, exert less outward pressure than when it is moving slowly. The wing of the airplane has been so designed that air is forced to move rapidly over its upper surface and slowly

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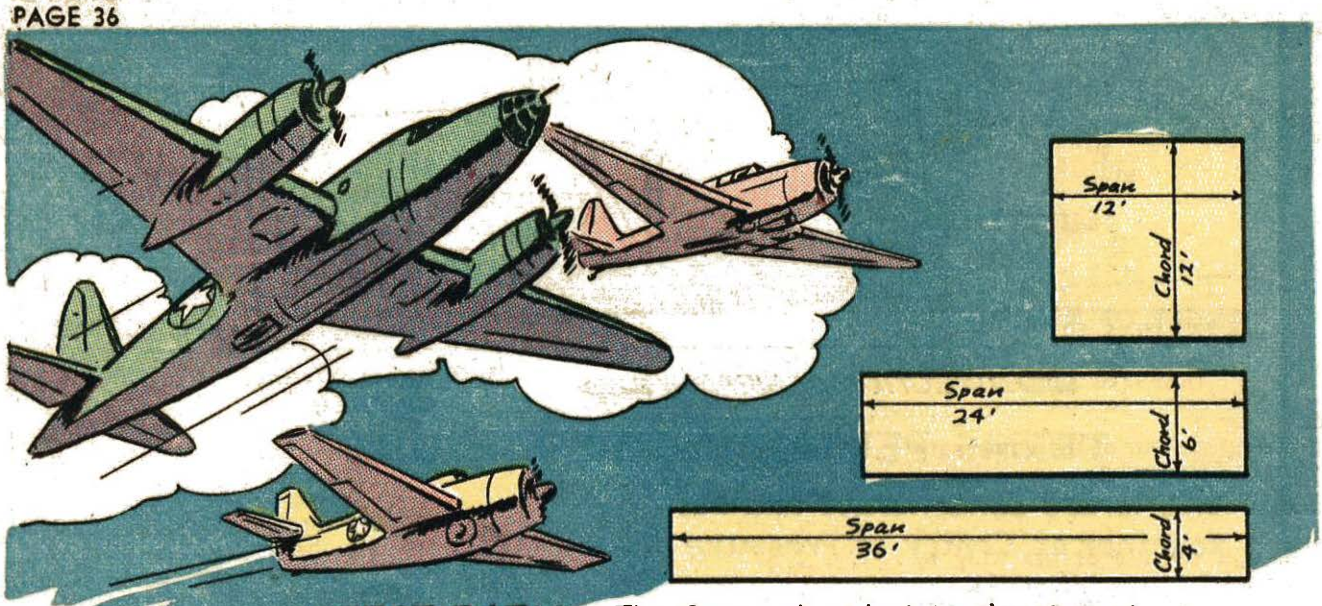
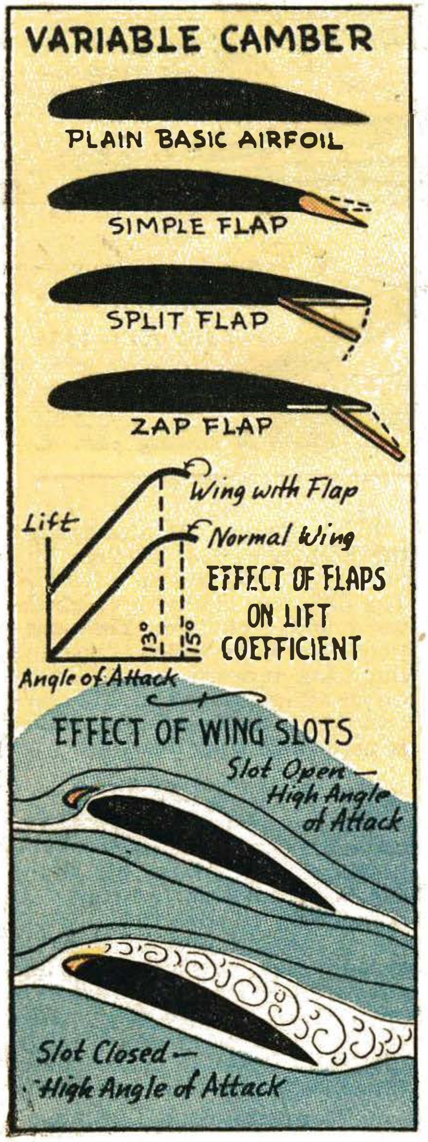


ASPECT RATIO — The Span divided by the Chord



across its lower surface. The result is that pressure of the air bearing down on the upper surface of the wing is less than the pressure of the air pushing upward on the bottom of the wing. The difference between these two pressures is a powerful lifting force. The extent of this force depends upon the design and area of the wing, the speed of the plane (or the velocity of the relative wind), the angle of attack and the density of the air.

AN EXAMPLE OF LIFT

Atmospheric pressure at sea level is 14.7 pounds per square inch. If this is the pressure that is pushing upward against the bottom of the wing, the pressure bearing downward against the top of the wing, when it is in motion, might be only 14.5 pounds per square inch. The difference of .2 pounds per square inch is the atmospheric-pressure lift of that particular wing at a certain angle of attack in a certain relative wind. Each square foot of wing area then would be developing a lift of 28.8 pounds.

Relative wind exerts forces of varying degree over every square inch of the wing. When the results of all these forces are collected, they are equal to a single force exerted in a single direction at a single point. This combined force is called the resultant. The point between the leading and trailing edge of the wing where this theoretical force is exerted is known as the center of pressure. The center of pressure is identified in the sketch on the preceding page by the letters c.p. The resultant is comprised of lift and drag.

Angle of attack is the angle formed by the chord of the wing and the direction of the airstream.

When the leading edge of the wing is lower than the trailing edge, in relation to the airstream, the angle of attack is known as a negative angle. When the leading edge is higher, the angle of attack is known as a positive angle.

Lift and drag both are affected by the angle of attack. As the angle of attack is increased, both lift and drag are increased.

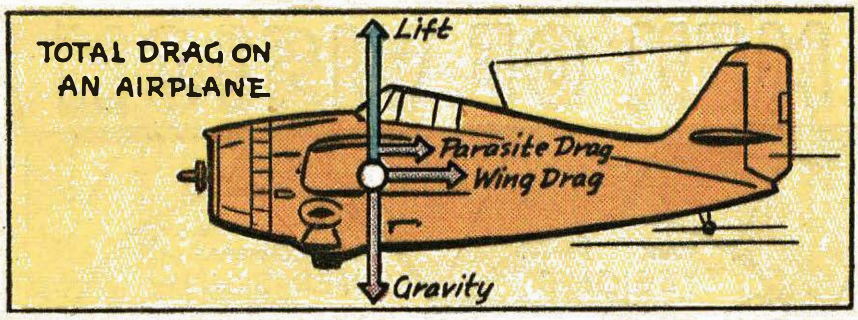
When the angle of attack is small, the center of pressure is far back on the wing. As the angle is increased, the center of pressure moves forward.

As the angle of attack is increased, a point eventually is reached where the wing develops the greatest possible lift. When the angle of attack is increased beyond this point of greatest possible lift, the stalling angle is reached.

Beyond the angle of greatest possible lift, there is a sharp decline in lift and a sharp increase in drag.

BURBLING DRAG

The reason for the decline in lift is because burbling is taking place in the airstream on the upper surface of the wing and with it a return of the air to more normal atmospheric pressure. Burbling is the formation of tiny whirlpools of air near the trailing edge of the wing which are created when the angle of attack is so great that the airstream is unable to follow the sharply



DRAG RETARDS MOTION and must be overcome by forward drive or thrust developed by the engine-powered airscrew. Drag created by the lifting surface is called wing drag; that caused by fuselage struts and other parts is called parasite drag. Friction of the wings causes friction drag.

pitched contour of the upper surface of the wing.

LOW ANGLE, HIGH SPEED

Lift is the force developed through the use of the wing to oppose the natural force of gravity. To maintain the level flight of the plane, a force equal to gravity must be exerted at all times. As the value of the lifting force depends both upon the angle of attack and the airspeed, an increase in either will increase the lift. When the angle of attack is low, the speed of the plane must be increased to maintain the lift force. When the angle of attack is high, the speed of the plane may be reduced.

The amount of lift required is determined by the weight of the plane and its load.

Drag is the force which retards the forward motion of the plane. It must be overcome by thrust which is developed by the propeller through the power of the engine, in the same way that gravity must be overcome by lift developed by the wings in an airstream.

Drag is the resistance of the airplane to the airstream. It is divided into two parts. One part is known as wing drag and the other part as parasite drag.

Wing drag is the resistance of the lifting surfaces to forward motion. Wing drag likewise is broken down into two parts: profile drag and induced drag. Induced drag is increased or decreased according to the speed of the plane and the angle of attack. Profile drag is the friction of the skin of the wing against the airstream. Skin friction is minimized when the surfaces of the wing are highly polished, but it cannot be eliminated. Tiny units of air in the airstream collide with minute irregularities in the surface of the wing, bounding back and forming little pockets of resistance.

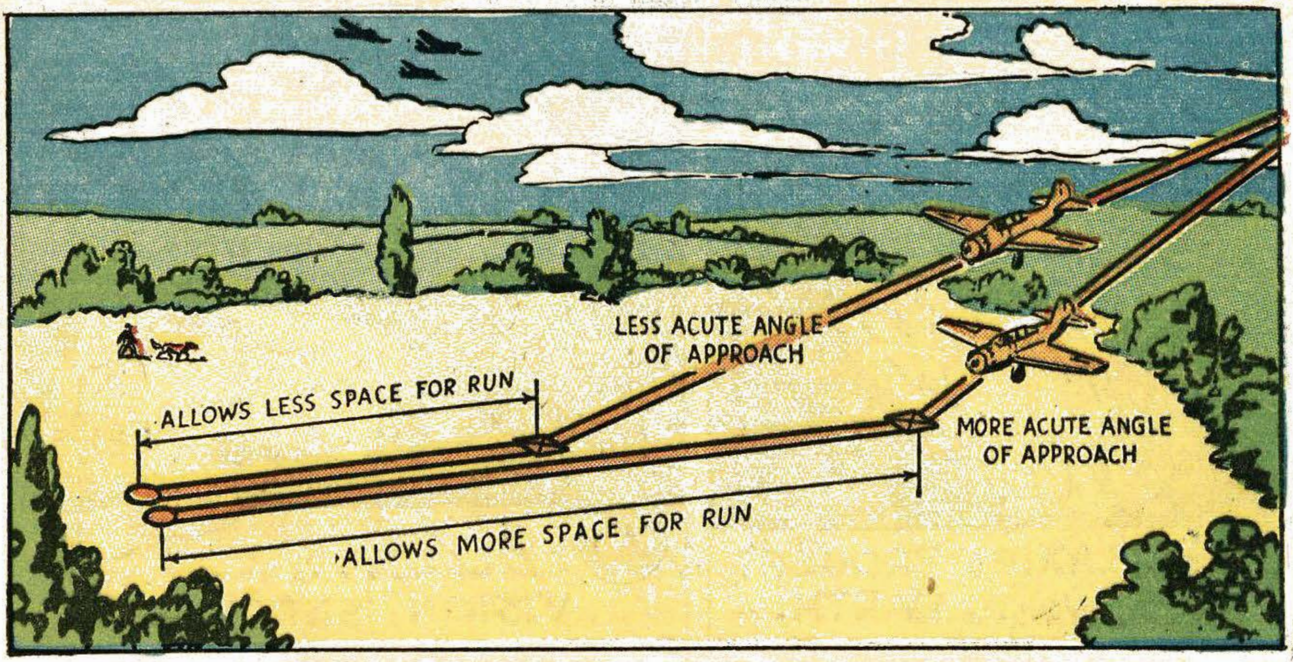
THE WINGTIP VORTEX

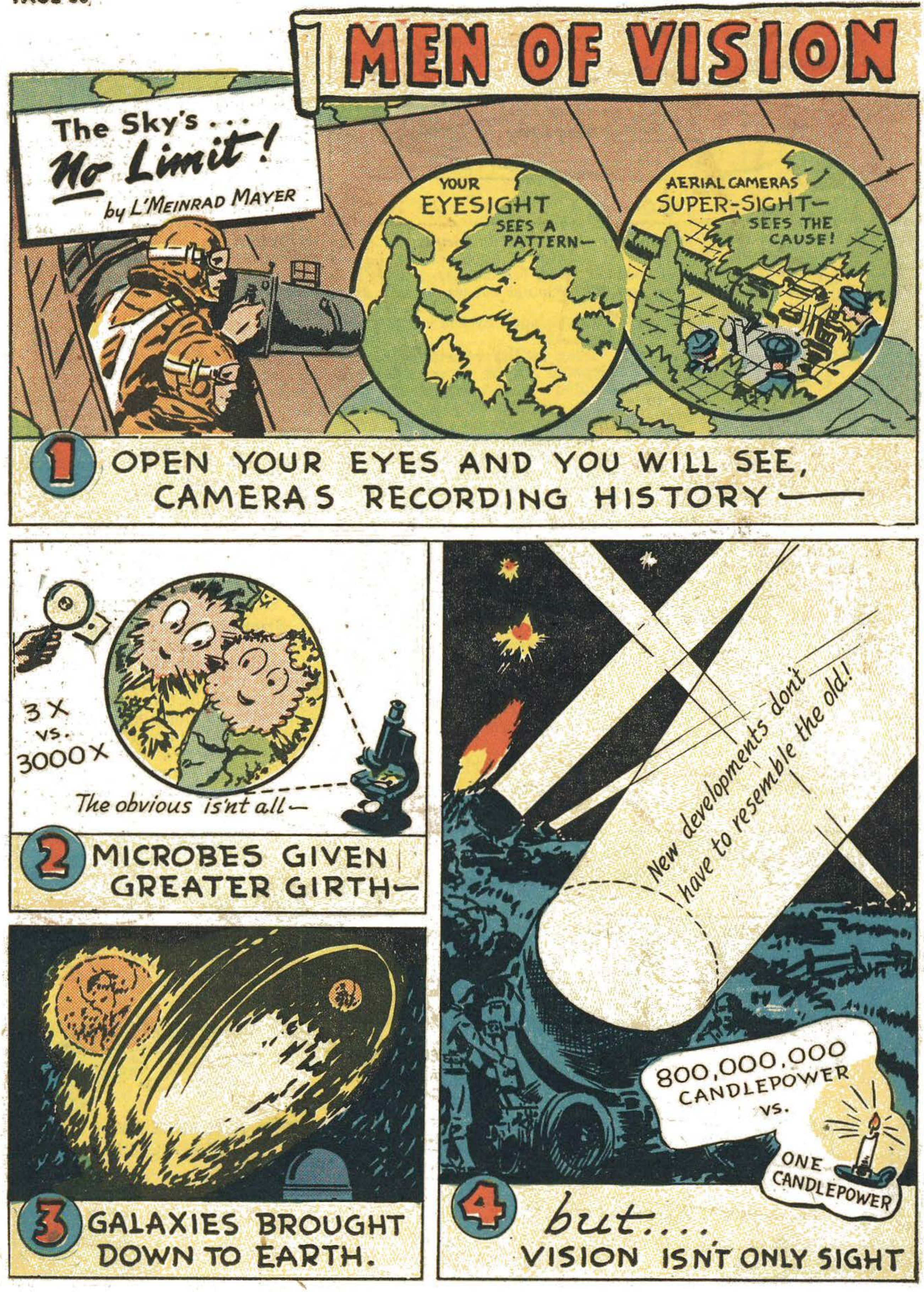
The difference between the atmospheric pressure at the top and bottom of the wing is responsible for a vortex at the wing tips which further contributes to drag. Air from the high-pressure area below the wing swirls over at the wing tip into the area of low pressure. When wings are short, the vortex at the wing tips has more effect on the wing than it does when wings are long. In order to establish a form for drag, therefore, it is not sufficient to know merely the wing area, for its shape is also important. For this reason, the term aspect ratio has been created. Aspect ratio is the length of the wing divided by its width, or its span divided by its chord. The effect of wing-tip vortex on a wing having a high aspect ratio is less than on a wing having a low aspect ratio.

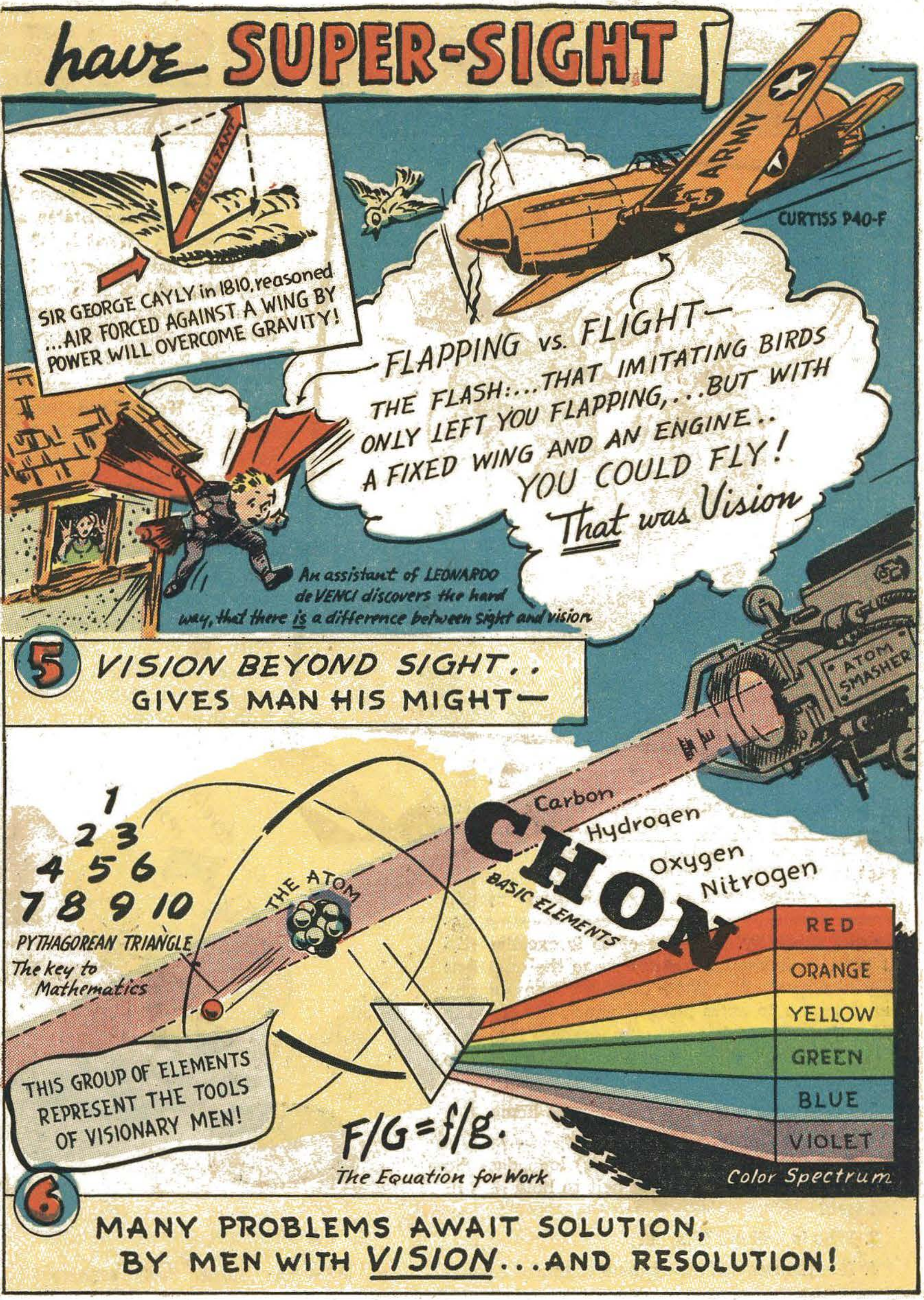
Parasite drag is resistance set up by all surfaces of the airplane other than the wing, such as the fuselage and landing gear. Parasite drag is divided between drag caused by the positive pressure of the air against the facing surfaces of the plane, and the friction resulting from the air passing over those surfaces.

HOW TO REDUCE DRAG

Streamlining reduces drag. When a flat or blunt object is passed through the air it is opposed not only by positive air pressure against its facing surface but also by burbling which sets up in its wake and tends to hold it back. A drop of water assumes, as it passes through the air, the shape least disturbing to the airstream which is flowing past it.




MEN OF VISION
The Sky's ... No Limit!
by L'MEINRAD MAYER
YOUR EYESIGHT SEES A PATTERN—
AERIAL CAMERAS SUPER-SIGHT— SEES THE CAUSE!
1 OPEN YOUR EYES AND YOU WILL SEE, CAMERAS RECORDING HISTORY—
3 X VS. 3000 X
The obvious isn't all—
2 MICROBES GIVEN GREATER GIRTH—
New developments don't have to resemble the old!
800,000,000 CANDLEPOWER VS.
ONE CANDLEPOWER
3 GALAXIES BROUGHT DOWN TO EARTH.
4 but... VISION ISN'T ONLY SIGHT


have SUPER-SIGHT
RESULTANT
SIR GEORGE CAYLY in 1810, reasoned ...AIR FORCED AGAINST A WING BY POWER WILL OVERCOME GRAVITY!
ARMY
CURTISS P40-F
FLAPPING vs. FLIGHT—
THE FLASH:...THAT IMITATING BIRDS ONLY LEFT YOU FLAPPING,...BUT WITH A FIXED WING AND AN ENGINE.. YOU COULD FLY!
That was Vision
An assistant of LEONARDO de VENCI discovers the hard way, that there is a difference between sight and vision
5 VISION BEYOND SIGHT.. GIVES MAN HIS MIGHT—
ATOM SMASHER
1
2 3
4 5 6
7 8 9 10
PYTHAGOREAN TRIANGLE
The key to Mathematics
THE ATOM
Carbon
Hydrogen
Oxygen
Nitrogen
CHON
BASIC ELEMENTS
RED
ORANGE
YELLOW
GREEN
BLUE
VIOLET
Color Spectrum
THIS GROUP OF ELEMENTS REPRESENT THE TOOLS OF VISIONARY MEN!
F/G = f/g.
The Equation for Work
6 MANY PROBLEMS AWAIT SOLUTION, BY MEN WITH VISION...AND RESOLUTION!

CADET QUIZ

BY MILTON FIGEN

A.

A PILOT ORDERS A CRASH AND A SIDESLIP AT AN AIRPORT RESTAURANT. WHAT DOES HE GET?

HOW well do you know the terms which are common among military airmen? Here is an opportunity to test yourself. Don't expect to get all of the questions correct, for some of the expressions are slang peculiar to certain areas. Count five points for each question answered correctly. A score of 85 is excellent, 75 is good, 60 is average. Answers to the questions appear on Page 58. Write down your answers by numbers, on an extra piece of paper, then turn to Page 58 and mark your own grade. Put your friends through this test and see if they can do any better.

1. What type of military flyer is at home in a pea shooter?

2. In making an ordinary (inside) loop, does the pilot depend upon his safety belt to hold him in his seat?

3. Who is Tailend Charlie?

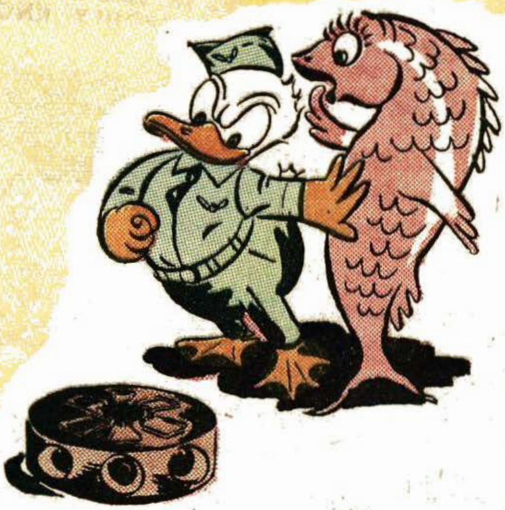
4. It is the name of an airplane engine of American manufacture. It is also the name of a United States airplane carrier. What is it?

5. On what American holiday, 1942, did United States Air Force bombers take part in their first raid over German-occupied territory?

6. Ambassador Winant, the Duke of Kent, Lord Beaverbrook, Prime Minister W. Mackenzie King and Lord Halifax all used the Atlantic Ferry Service. All crossed the ocean in the same kind of American bombing plane. What was it?

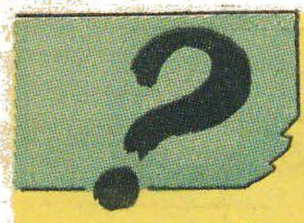
7. He is good to the last drop. Who is he?

8. Their designations are TBF, PBY and F4F. Their names are Wildcat, Avenger and Catalina. Match the names with their proper initial designations.



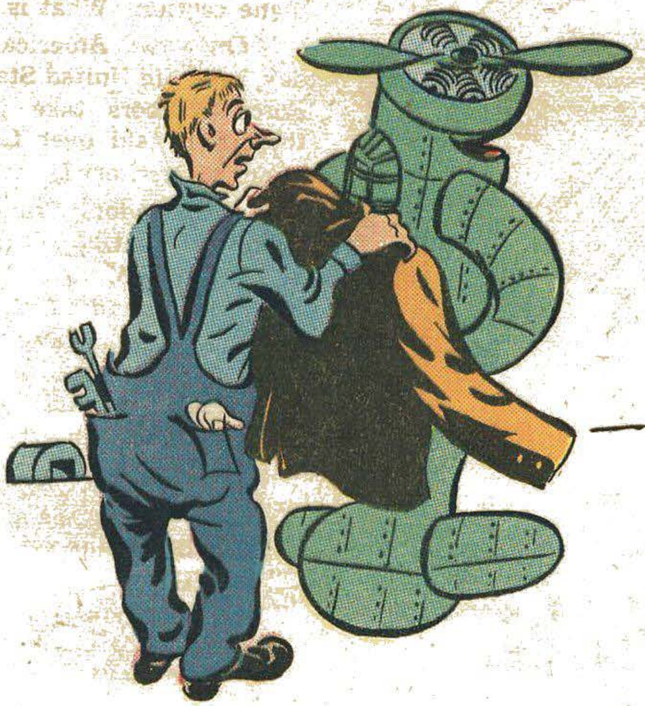
B.

A DUCK ON KIPPER PATROL SPOTTED A MOUSETRAP. WHAT DOES THIS MEAN?



C.

AN AVIATOR *FLYING THE WET-BEAM* WOULD BE DOING WHAT?



D.

ONE KIND OF AIRPLANE SLEEVE IS A COVERING FOR WINGS OF A SHIP LEFT IN THE OPEN. THERE ARE SLEEVES IN THE ENGINE. ANOTHER SLEEVE IS MORE COMMONLY KNOWN. WHAT IS IT?

9. He is closely associated with dollies, doilies and aprons. Who is he?

10. What is a cow-pilot?

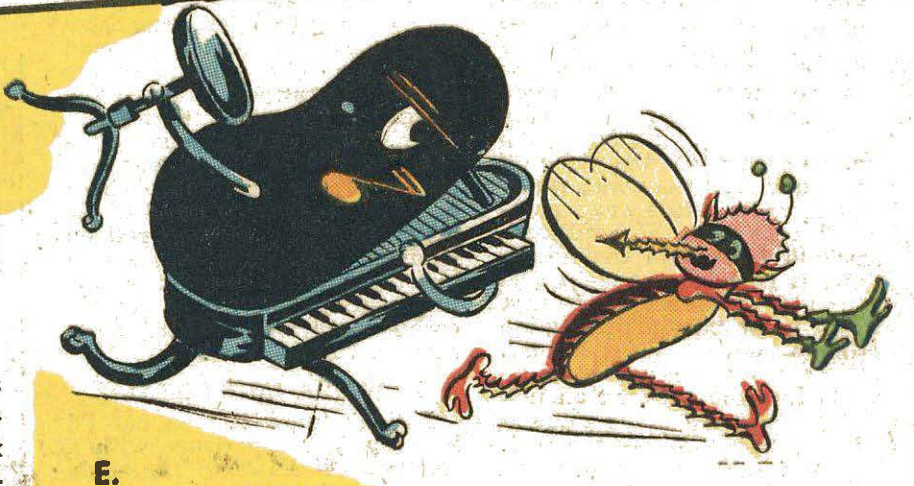
11. One of the first reactions of a pilot flying too high without wearing his oxygen mask is (1) vertigo, (2) loss of confidence, (3) diminution of visual powers, (4) craving for cigarettes. Only one of these is wrong. Which is it?

12. What is happening when the brass nut goes out to inspect the joy wagon?

13. War planes in string formation give the appearance of flying in a train with each ship directly behind the one ahead of it. Why is it that this cannot be true?

14. The name of a German gun is "fliegerabwahrkanone." What do English and American pilots call the product of this gun?

15. It is variously called "fanny," "flag" and empennage." What is it?



E.

WHY IS A *CHICAGO PIANO* A PROPER INSTRUMENT TO BE USED FOR DRIVING AWAY AN ANNOYING *GEORGIAN MOSQUITO*?

Rainbow at night

By ERNEST G. VETTER
Lieutenant, U. S. Naval Reserve
Author of "Visibility Unlimited" and "Let's Fly."

THE heavy dark cloud southwest of the field was plainly visible. There could be no doubt that a storm was approaching. It looked severe. But the inspector who gave the tests for pilot's licenses was due in a few days and I was certain that there was plenty of time for one more practice landing. I gave it the gun. No sooner was the plane off the ground than the wind, which a few minutes before was a moderate breeze from the southwest, struck in fury from the northwest. It pounded the right side of my plane with a violence that I never knew existed, driving me sideways toward the hangar. Just as we were about to be dashed into the building an updraft yanked the plane upward so that it barely missed the roof. Nearly paralyzed I did my best to get headed into the gusty wind and to keep the plane under control. It seemed an age before I could maneuver the airplane to the other side of the field to attempt a landing. By this time the downpour had started which added to my troubles. Somehow I managed to get on the ground where the helping hands of the boys at the airport grabbed the wings of the plane to hold it down. They had seen my difficulty and were ready. The velocity of the wind just about equalled the landing speed of the plane so that it did not roll on landing. Chagrined, still scared but thankful, it dawned on me that perhaps there was considerably more to this flying business than I had thought.

IT WAS A LINE SQUALL

I didn't know it then but I'd had my first experience with a line squall. Later in the study of meteorology I learned, more safely, about what pilots refer to as the wind shift line. The fact that this was not yet known as a "cold front" made no particular difference in its severity.

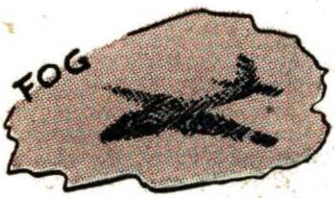
ATMOSPHERE IS GAS

As the safety and comfort of himself and passengers often depend upon a pilot's understanding of meteorology it behooves him to make as thorough a study of the subject as possible. Meteorology is the science of the atmosphere. This atmosphere is the layer of gases completely surrounding the earth that we know as "air." The condition, or change in condition, of this air or atmosphere is called weather. Weather and aviation are so closely allied as to be inseparable.

The atmosphere is divided into two parts by the tropopause which is about eight miles above the earth. The area below the tropopause is called the troposphere and that above is known as the stratosphere. The atmosphere is a mixture of several gases. Containing about 77 per cent nitrogen and 21 per cent oxygen the remaining 2 per cent is made up of argon, hydrogen, xenon, krypton, neon and helium. These gases exist in nearly the same proportions over all parts of the world and up to a height of many miles. They are kept mixed by the currents of air blowing over the rough surfaces of the earth.

VAPOR IS IMPORTANT

In addition to the gases that make up the atmosphere there are two other constituents that are very important. These are dust and water vapor. The



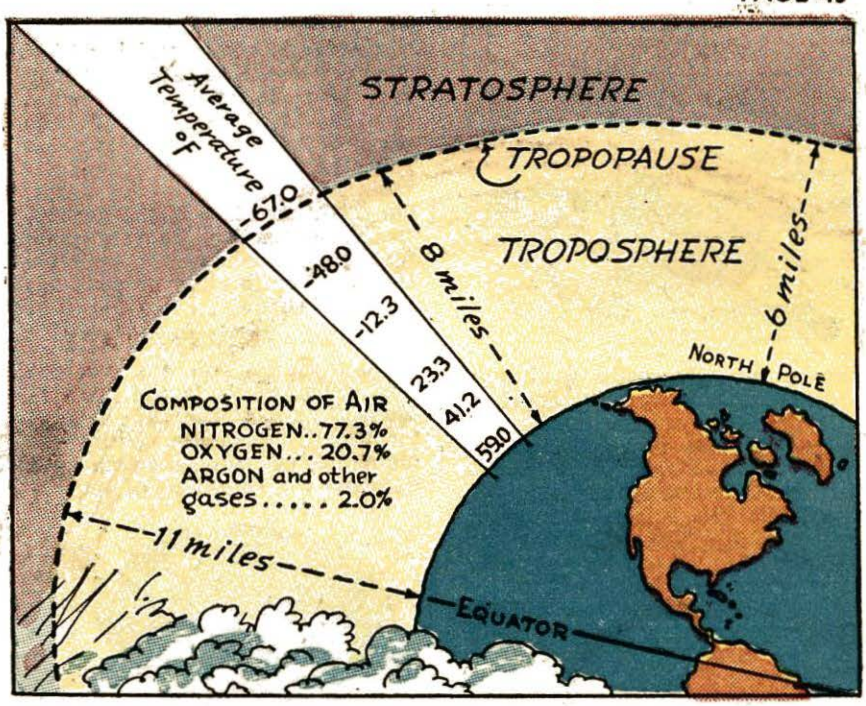
amount of water vapor in the air largely determines the type of weather we might have. Water vapor itself is invisible. When the air becomes saturated, condensation will take place. Water vapor then becomes visible as fog, clouds, rain, etc. For condensation to occur small particles are necessary in the air upon which the process begins. Dust particles act as these nuclei and as such are

an extremely important factor in weather genesis.

WHERE AIR IS THIN

Above the tropopause in the stratosphere almost ideal flying conditions exist. There are no clouds, wind or storms to hinder and annoy the aviator. This region is very cold, however, and because of its height it is difficult to reach. The air is very thin and it is impossible for men and machines to fly there unless special provision has been made. Flights are being made in the stratosphere at present but these are largely experimental or wartime operations. The commercial airways of the future, which will encircle the globe, will be found in this region.

In the troposphere appear the



various weather phenomena such as wind, clouds and storms. As this is where you and I will be doing our flying, and our neighbors after the war, it is this region that we are chiefly interested in at this time.

KNOW THE WEATHER

Meteorology is a complex study but at the same time an extremely fascinating one. One does not have to be a scientist, however, to have a practical knowledge or understanding of the subject. The needs of the aviator are met when he knows where to get weather information, to understand its significance and to use it to his best advantage.

In planning a flight a pilot is interested in several items but these come under two general headings, information about the visibility and about the wind. The wind is dangerous only when it is very gusty or of a high velocity. But if the visibility is poor one can not see to take off or land. Although flights are regularly made on instruments in conditions of poor visibility after the airplane is once in the

air, blind takeoffs and landings are still in the experimental stage. Visibility is measured both horizontally and vertically. The horizontal visibility is measured in miles and the vertical visibility, or ceiling, is measured in hundreds and thousands of feet. Restrictions to visibility are undoubtedly the greatest weather factor affecting aviation at this time.

WHAT TO CHECK

It is not a sound practice to start a flight merely because the weather conditions are satisfactory at the home airport. These do not necessarily have to continue and there is no guarantee that the weather will be favorable at the destination. This brings up other problems that must be met by the pilot before he can begin his flight and expect to arrive safely. He must know the weather along the route and at the destination and whether or not it is likely to change.

THE WEATHER BUREAU

In order that aviators can have the weather information that they require the United States Weather Bureau has developed a marvelous service. For many years the Weather Bureau has provided free weather information to farmers and seamen to help them gain their livelihood. With the growth of aviation it was easy to adapt these facilities to aviation. Having had stations in all large cities, daily weather

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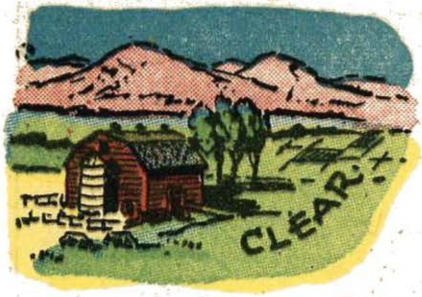


reports were already available. Other stations were established on the airways that connected these cities so that weather all along these airways could be determined. By use of the telephone and radio this information could be sent to the places where it was needed. More recently the teletype has come into use so that by an exchange of weather reports all stations along a given route can be kept informed of the weather all along the route.

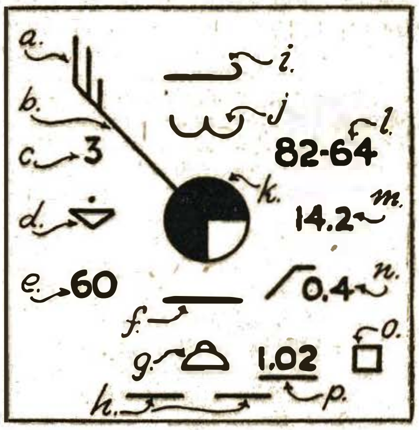
WEATHER IS MOVING

Stations off the airways also take observations and send them in to key stations along the way. These observations are all taken at a common time and give a picture of the weather at that time over a wide area. It was Benjamin Franklin who discovered that weather moves. Not only does it move but it moves in fairly well defined paths and at certain speeds. Therefore when a pilot knows what the weather is and understands where and how fast it will move, it is relatively easy for him to determine what changes will occur. If the weather is clear all along his route he can decide if it will remain so or change for the worse. On the other hand if it is not entirely satisfactory he can make up his mind whether to wait for the weather to clear or give the flight up entirely.

WHAT "ELEMENTS" ARE

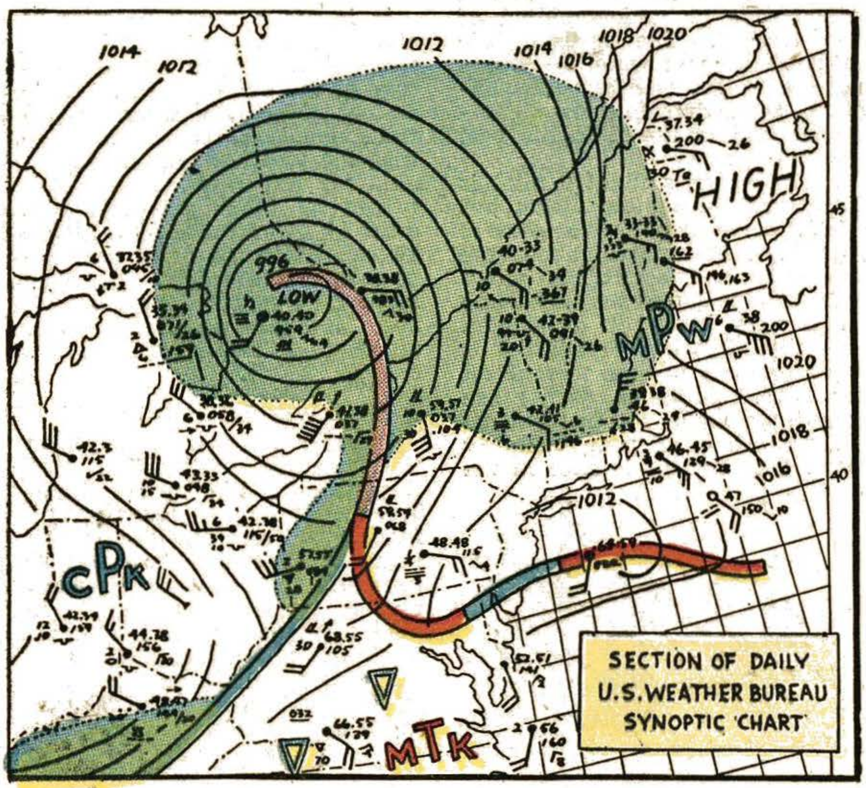
In reporting on the various weather phenomena the meteorologist makes use of several terms called elements. With these elements he can ascertain and describe the condition of the at-

mosphere at any particular time or place. The most important of these elements are: the temperature of the air, its pressure, wind direction and velocity, humidity, the type and amount of clouds and the amount and kind of precipitation. The aviator is interested in the additional elements of visibility, ceiling and the general state of the weather. After observations are made at the various stations they are made up into a code for brevity in trans-

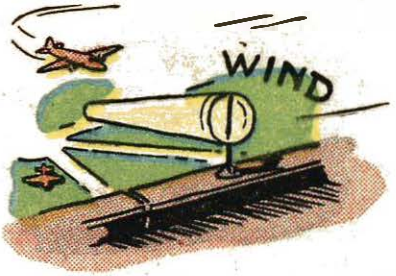


WEATHER MAPS use symbols to impart information quickly. At a is the symbol for wind force; b, surface wind direction; c, visibility in miles; d, weather by symbols; e, ceiling height in hundreds of feet; f, red line indicates a thunderstorm; g, lower clouds; h, direction and force of wind; i, higher clouds; j, middle clouds; k, amount of sky covered by clouds; l, dew point; m, temperature; n, barometric pressure; o, pressure change; p. time of precipitation (red); q, precipitation in inches.

mission. This code is then sent to the various other stations along the airways so that when it is decoded each station can know the weather at all the other places.



SECTION OF DAILY U.S. WEATHER BUREAU SYNOPTIC CHART

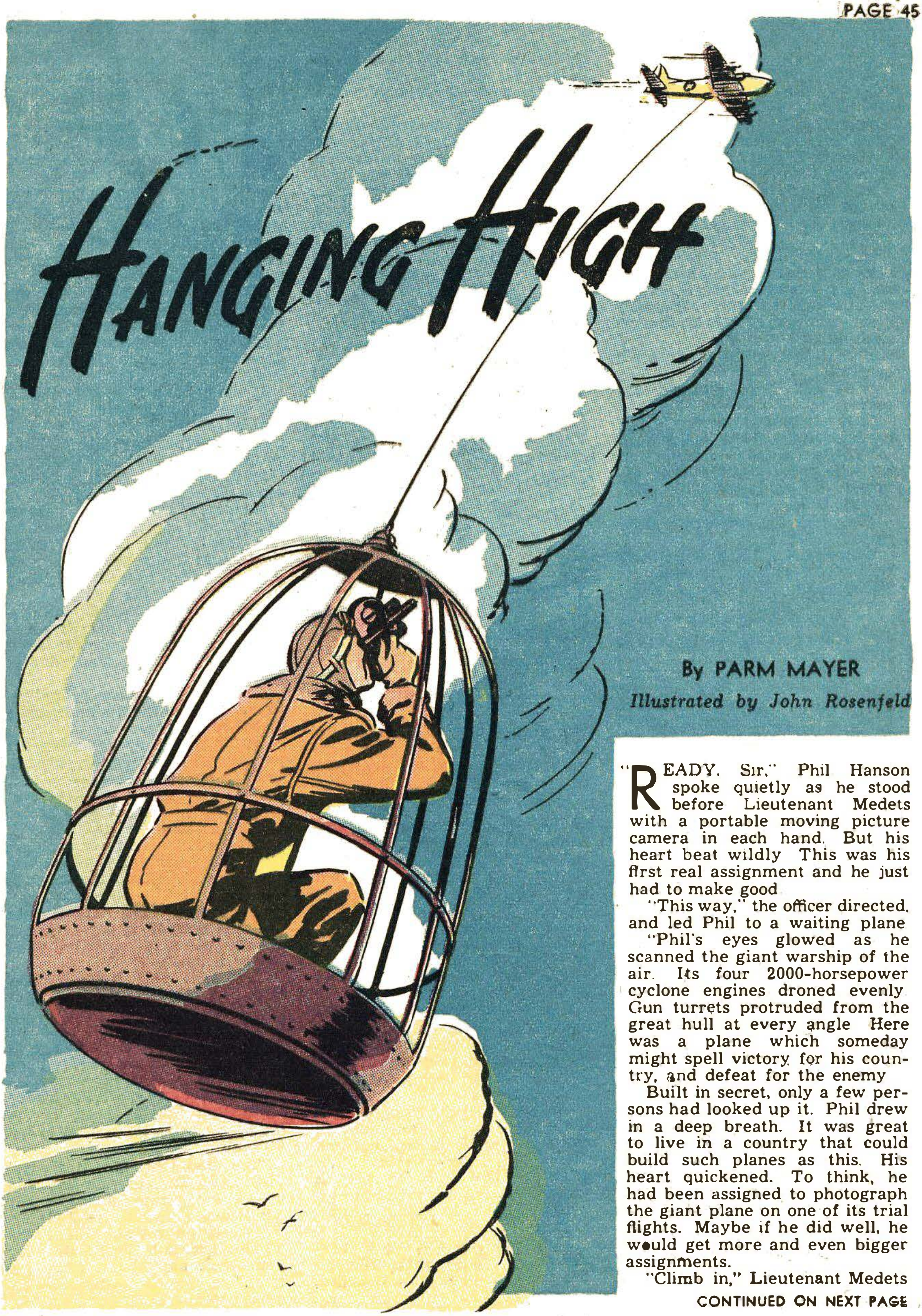


Normally all an aviator has to do is to ask the weather man for advice. The meteorologists of the Weather Bureau are very courteous and eager to help. In the case of the Army, Navy and Airlines, however, pilots are usually not permitted to fly cross country unless they have a clearance from the weather man. But it is not always practical to have a trained meteorologist available. Under these circumstances it will be necessary for the aviator to decide for himself whether or not it is safe to fly.

Make no mistake about it—if you want to fly you must know meteorology.

Later articles will take you further into this absorbing study.

Hanging High



By PARM MAYER

Illustrated by John Rosenfeld

"READY, Sir," Phil Hanson spoke quietly as he stood before Lieutenant Medets with a portable moving picture camera in each hand. But his heart beat wildly This was his first real assignment and he just had to make good

"This way," the officer directed, and led Phil to a waiting plane

"Phil's eyes glowed as he scanned the giant warship of the air. Its four 2000-horsepower cyclone engines droned evenly Gun turrets protruded from the great hull at every angle Here was a plane which someday might spell victory for his country, and defeat for the enemy

Built in secret, only a few persons had looked up it. Phil drew in a deep breath. It was great to live in a country that could build such planes as this. His heart quickened. To think, he had been assigned to photograph the giant plane on one of its trial flights. Maybe if he did well, he would get more and even bigger assignments.

"Climb in," Lieutenant Medets

CONTINUED ON NEXT PAGE

directed and opened a door in the side of the plane.

Phil stepped up into the plane and sat down beside a soldier who was already there. Lieutenant Medets followed. The lieutenant signaled to the pilot and the giant warplane roared down the runway. Soon it was soaring above the isolated airport.

At four thousand feet, Lieutenant Medets motioned to Phil. "Here's where you get out." He smiled and opened a trap door in the bottom of the plane. Concealed beneath the door was something which looked like a small metal bathtub. "We call that a cloud car," the lieutenant explained.

Phil smiled and picked up his cameras.

"Get in," the lieutenant directed.

Phil climbed into the cloud car and adjusted the safety belt.

"You won't have room for both of these," the young officer informed as he nodded at Phil's two cameras.

Phil handed the officer the older camera of the two.

"Going down," said the soldier who stood at the windlass and started the gears of the small windlass in motion.

Phil felt himself being lowered slowly through the opening in the bottom of the plane on a wire which unwound from the windlass. He couldn't help noticing how thin the wire looked. "About as thick as stout packing cord," he thought.

A great gust of wind tore at his face the moment he emerged through the bottom of the plane. Phil was glad it was traveling at its cruising speed of one hundred and fifty miles an hour, and not at its top speed. He put an arm across his face and gasped for breath. Soon he was able to breathe more comfortably.

Down, down, down. Before long he was swerving in great arcs. His heart beat fast as he clutched the side of the cloud car. What a way to make a living. Maybe he should have stuck to his original intention of being a wireless operator.

At one hundred feet the swerving became less violent. At two hundred it had practically stopped. Phil relaxed his grip on the sides of the car and smiled a little. He looked up at the plane, high above and considerably ahead of him. He thought how much like a spider he was, dangling there at the end of his wire web.

At four hundred feet the car jerked a little as it came to a halt. This was the length of descent agreed upon. Carefully, Phil got out his camera and sighted the roaring plane overhead. It was barely visible through a cloud through which it was passing.

Phil waited a moment. As the big ship nosed into the bright sky between clouds, he started his camera, watching carefully to be sure and catch every movement of the great plane which would mean so much to the designing engineers.

Again and again the wheels

he sharp dots and dashes of the Morse code came singing over the taut cable "Use old camera to repair windlass. Tear it apart."

of his camera whirred as he focused on this or that phase of the maneuvers of the great ship. He was sure he was getting what the officers had told him they wanted.

The cloud car jerked a little. Phil looked at his watch. The half-hour agreed upon was up. Quickly he put his camera away and snuggled down.

Slowly the small compartment started the long climb back to the plane. Phil smiled to himself. He had done a good job. He had done his bit in aiding his country's war effort.

Abruptly the car stopped. The wire to which it was hitched trembled. Phil bolted upright. There was a sudden snap. The wire twanged and whined as though it were being hammered.

Phil's heart thumped. Something must have gone wrong.

He waited for the car to start ascending again. But although the wire snapped and twanged, the car didn't rise a foot. Something indeed was wrong!

A half hour passed. Then an hour. And still Phil hung suspended in the cloud car. Perspiration gathered on his forehead. How long would the plane be able to stay aloft. Usually, on a test flight, a plane carried just enough gas for the trip.

Phil looked down. They were over the airport now. He could see an ambulance and a fire-truck drawn up at one end of the field. Phil shuddered. The significance was all too obvious.

He tried to think but his head pounded. He knew the men in the plane were doing all they could. No doubt the windlass had gone wrong. Could they fix it in time?

It must have been the pin in the cog that snapped. He had noticed it when he sat in the plane. Maybe they had nothing to use in its place. If—if only—they could find something on the plane to use—if—if only—

Suddenly Phil's face lighted up. His old camera! The one he had left in the plane. Maybe they could find a substitute part in it. But—but how was he going to get word to the plane?

Again his spirits sank. He imagined the motors of the giant ship were sputtering. The wire that held the car twanged and whined.

Abruptly Phil's face lighted up again. The wire! His knowledge of the Morse code!

He took a heavy key from his pocket and began tapping sharply on the wire. ". . . — — — . . ., . . . — — — . . ., . . . — — — . . .," he tapped out again and again.

Then, when he had all but given up hope, there came back from the plane, an answering tapping. GO AHEAD, the message read.

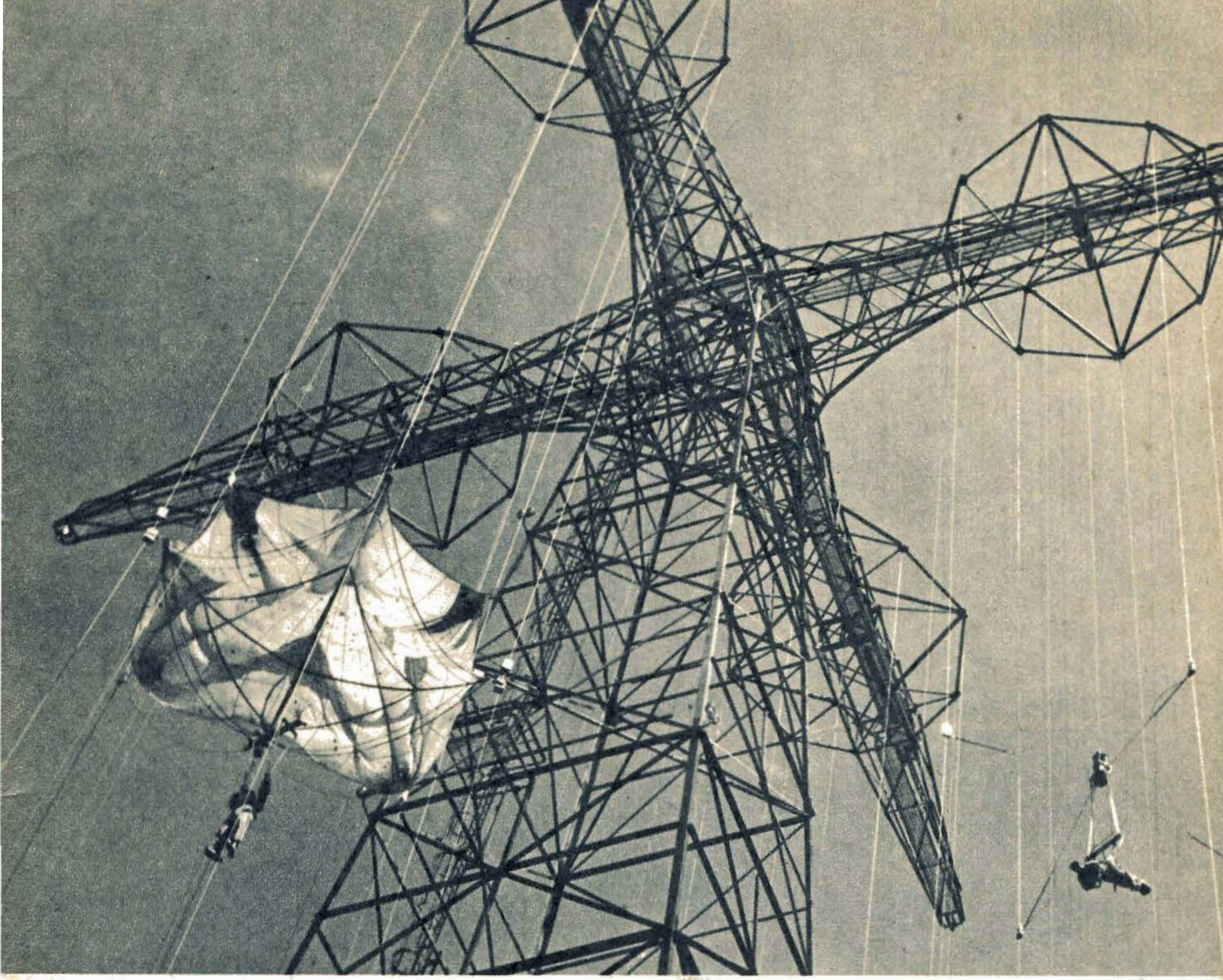
Feverishly, Phil tapped out what he wanted to say—the old camera, use it to repair windlass—tear it apart.

The next half hour seemed like a lifetime to Phil. When the cloud car started rising again he almost fainted. Not until he was hauled up into the body of the plane, was he really sure whether he was dead or alive.

"The old camera did the trick," Lieutenant Medets cried as the big plane began its descent to the airfield.

"I'm glad I brought it along," Phil said. Then patted the side of his other camera. "I've got 'em in here," he declared joyfully.

The officer smiled. "The army will be grateful. We'll talk over your next assignment after we land."



Rip Cords

NEWEST and fastest-growing of all branches of service in the U. S. Army are the paratroops. Into their ranks America is now funneling its finest fighting specimens, football players, wrestlers and athletes of all kinds. Months are devoted to an intensive program of training and muscle-hardening which not only develops the paratrooper as a skilled parachutist but as a master of every art and artifice of modern warfare—a demolitionist, a tommy-gunner, a grenade thrower and a rough-and-tumble fighter knowing every trick of the trade.

Learning to jump, control a parachute and land without injury is only one part of the entire paratroop-training schedule. Although jump-training has been

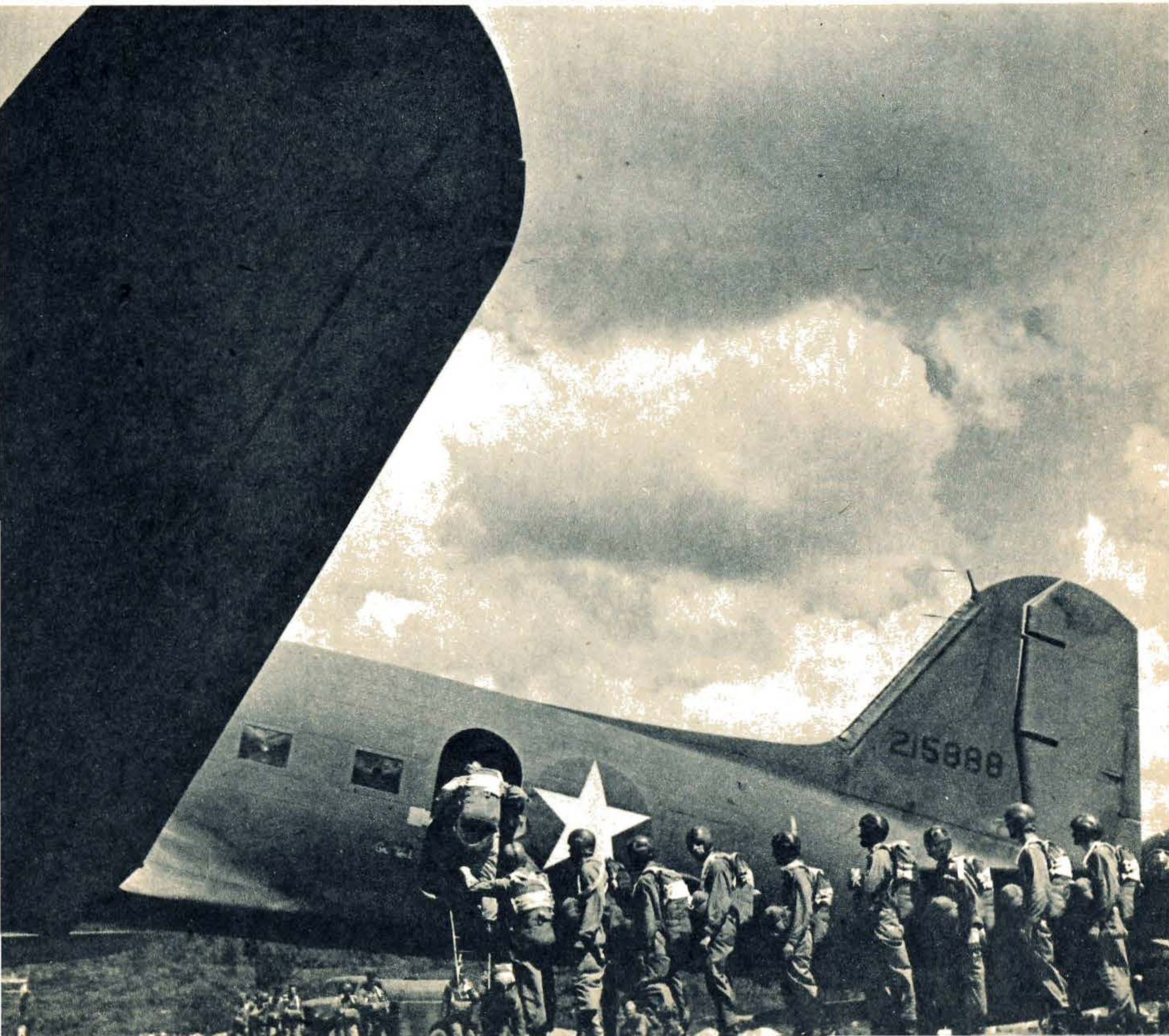
CONTINUED ON NEXT PAGE

reduced to a science, it remains the most exciting part of the program.

Training begins with leaps off eight-foot platforms which strengthen the men's ankles and teach them how to land with their legs relaxed. Next, they advance to giant, 250-foot towers like the one which was used as an amusement at the New York World's Fair.

The large tower is built of steel. It has four arms extending out from its sides. There are guide cables which reach down from the arms to the ground. The first jumps made from the tower are with the parachutist seated in a chair. The speed of the descent is regulated from the engine room, where the cables are wound around huge drums.

During the first six weeks of their training, paratroopers are encouraged to run, never to walk, and their course in calisthenics and physical conditioning is strenuous. At the end of this six-week



period, they make their first jump from an airplane. Twenty men are carried aloft in a big, hollow transport, each with an emergency parachute on his chest as well as a regulation parachute on his back. Attached to the chute on his back is a rope with a snap hook. When ready to jump, the hook is snapped onto a static line which runs the length of the plane. At the command to jump, the instructor leads off, followed man after man at one-second intervals. If the regulation chute fails to open at the end of four seconds, the jumper pulls the rip cord of his emergency chute.

Five jumps from a plane in flight are required before a paratrooper is graduated from the parachute school. Then he receives silver wings.

PARA-MARINES *in Action*

MORE heavily armed and highly trained than any other foot soldier in the armed forces, the parachute trooper is a veritable one-man army—and the U. S. Para-marine is the toughest of them all. Picked men to start, para-marines are hardened by months of intensive exercise, taught how to use all kinds of weapons and how to protect themselves without weapons in "bar-room" or "dirty" fighting tactics. They are taught how to work together as a team so that each man protects the next one, and how to work alone, against odds, in daytime or after dark.

In the photograph below is a marine landing and bracing his feet to spill wind from his silk canopy. He pulls on the lower shroud lines and falls to the ground to avoid being dragged. Parachute troopers frequently are called upon to jump from as low as 300 feet above ground.

MARINES HAVE LANDED, above, and rush ahead in simulated seizure of an enemy airfield.

SCOUTING MARINE advances with a Reising gun, a short, compact weapon, effective at short range.

CARDBOARD IMAGES pop out from behind trees to confront paramarine in the course of his training.

MORTAR IS A NEUTRALIZER, used to blast out enemy machine gun nests, especially when they are hidden behind the slope of a hill. The 60mm. mortar and its ammunition are dropped in parachutes from airplanes.

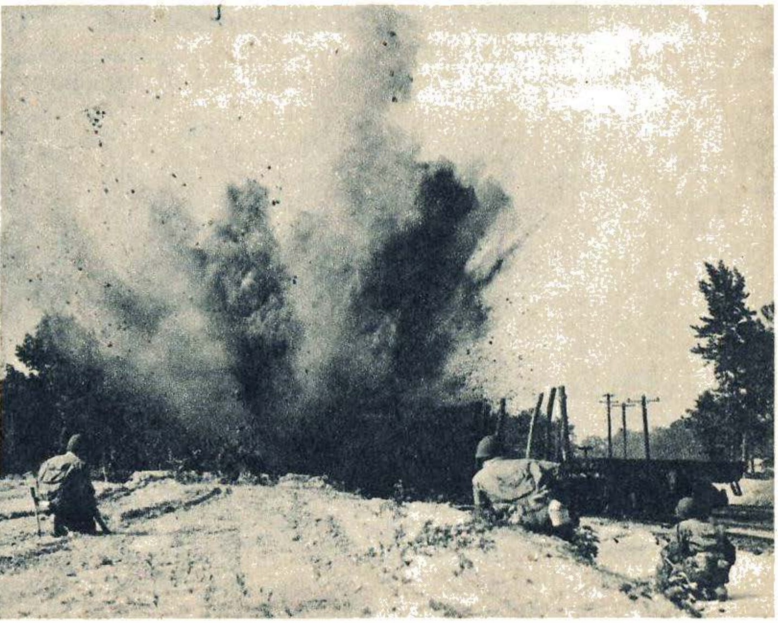
BROWNING MACHINE GUN is dropped disassembled from airplane, but is put into action quickly by efficient crew.

PINEAPPLES are the favorite fruit of the hard-hitting marines who toss them with vengeance.

IF YOUR OPPONENT pulls a gun on you, put his eyes out. This marine demonstrates the method.

IF HE LUNGES with a bayonet a quick side-step and turn will enable you to grab the rifle

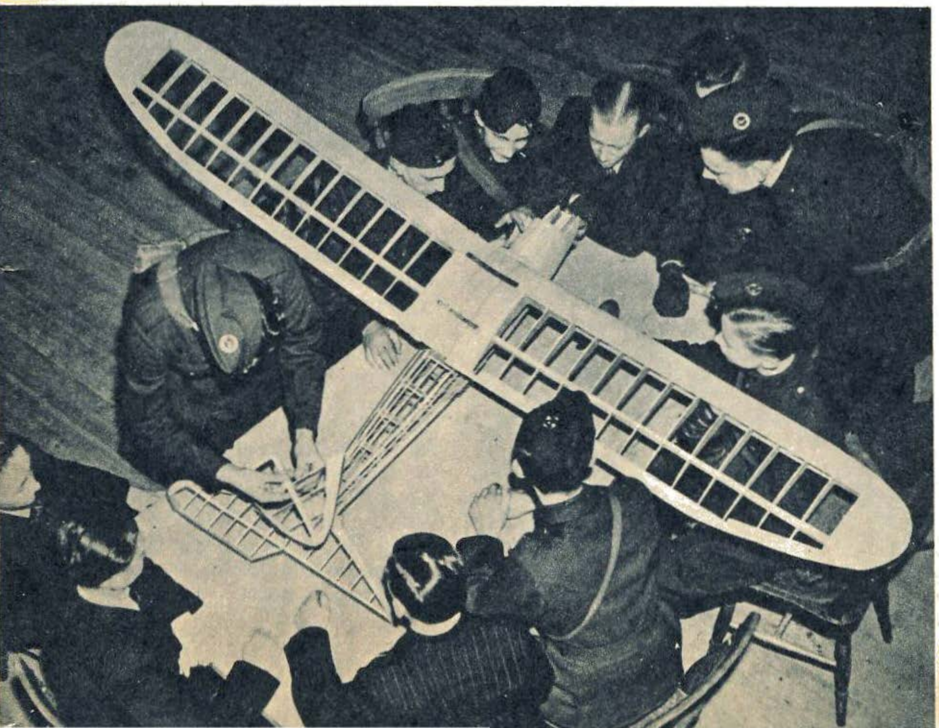
IN TWO PICTURES ABOVE, an opponent with a knife is twirled around and disarmed. Fast action is required.



DEMOLITION is one of the most important phases of training. This group is planting a charge of TNT to blow up railroad tracks. Detonation is shown in picture at right.

R·A·F Cadets

CADETS WEAR UNIFORMS and are given ranks like those in the R. A. F. Younger cadets build gas-powered models, older boys are trained to operate gliders and light planes, are finally advanced into the R. A. F.



FIGHTER pilots of the R.A.F. are considered old men when they reach 24 years of age, and are then retired to inactive branches of the airforce. Airplane pilots of multi-engine planes reach their "ceiling age" at 30. These age restrictions are made necessary by the British desire to produce a finer air force than that of her enemy, man for man, and the fact that an air fighter is at his prime in his early twenties.

But this creates a serious problem in the replacement of pilots and members of the air crew. With replacement and expansion combined, thousands of new airmen are needed monthly. How the British have successfully tackled this problem can be seen by a glimpse into the workings of the British Air Training Corps, a vast and successful pre-flight training plan.

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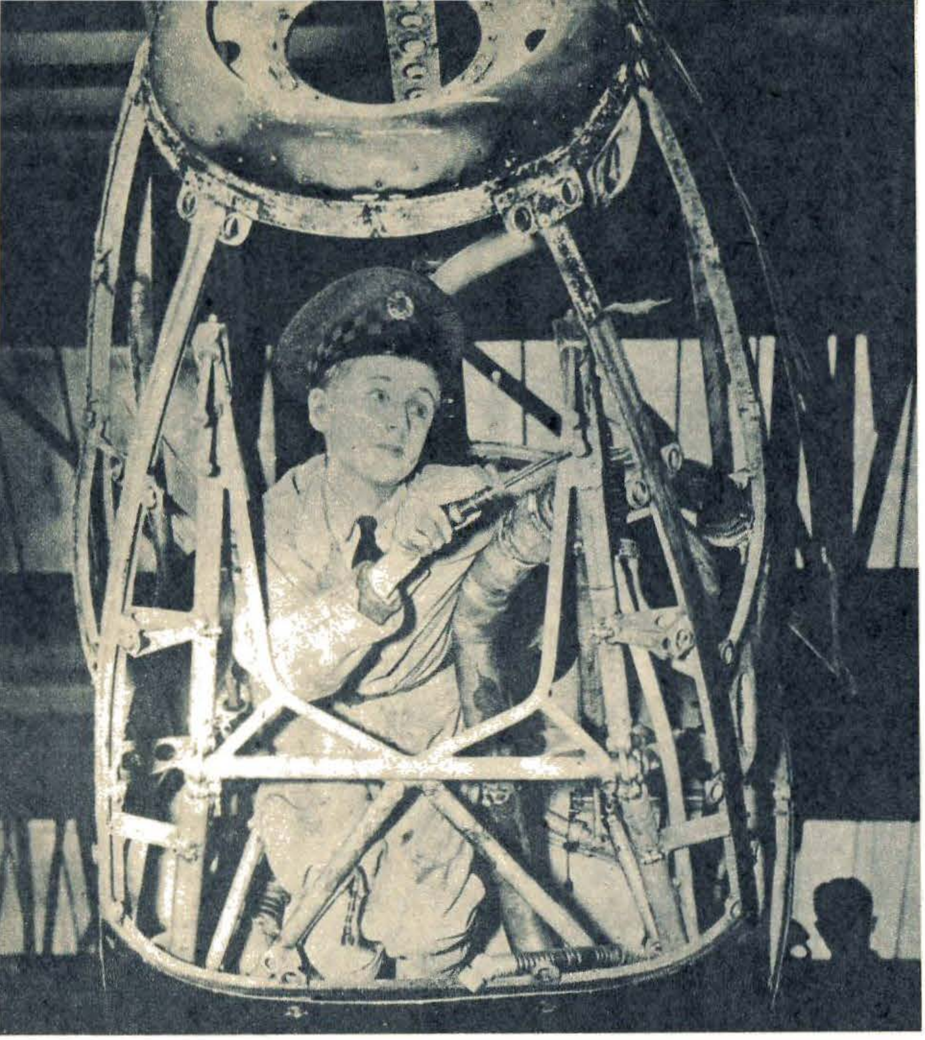
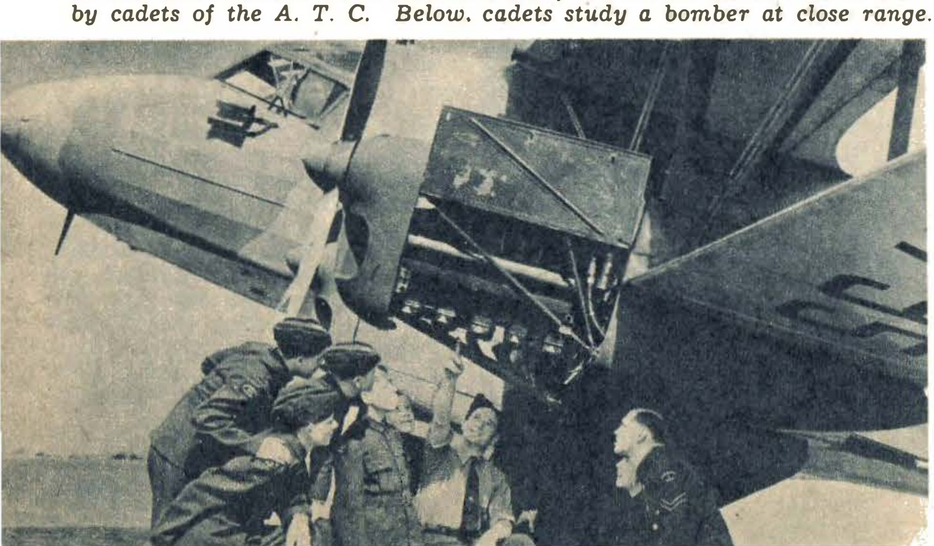


CADETS BUILD PLANES. *Classroom and shop prepare boys unsuited for flying by teaching them trades which will qualify them eventually for entrance into an R. A. F. Technical Training School for ground crews.*

OUT OF SCRAP *from wrecked Nazi airplanes, chicken wire, bits from an old bedstead and other odds and ends, the trainer above was re-built by cadets of the A. T. C. Below, cadets study a bomber at close range.*



RAF CADETS

CONTINUED

Pre-flight training, through the A.T.C. is given to hundreds of thousands of boys under 18 years of age, who hope eventually to join the Royal Air Force or the Fleet Air Arm. A reservoir of classified, enthusiastic, semi-experienced, semi-trained young men thus has been created, from which the air forces may draw according to their needs.

Established in February, 1941, by the Air Ministry as a separate military unit, the A.T.C. is designed and organized as a miniature airforce. Members of the corps are the cadets of the R.A.F. The corps is divided into three sections: university air squadrons, secondary school squadrons, and local squadrons. A squadron consists of from 100 to 200 boys. They are all issued uniforms of R.A.F. blue with insignia and rank corresponding to those of the regular army. The A.T.C. has its own flying officers, flying sergeants, sergeants, corporals and privates, all of whom are boys. Instructors are furnished by the R. A. F., and hold commissioned officer ranks.

Specifically the A.T.C. aims for three goals. It seeks to fur-

nish pilot material, train aircrew personnel, and develop skilled mechanics and ground crewmen. Before cadets are trained for any one branch, all must complete the first phase of training which includes military drill, physical conditioning, aircraft recognition and Morse code. At this point instructors are able to decide for which section of the airforce a cadet is best suited. When classified, cadets are segregated into two groups: those adjudged suited for military flying, and those better equipped for

MOST EXCITING of all A. T. C. cadet activity is gunnery practice, in which all boys participate.

ground work. The training is carried on in connection with or in addition to regular school classes and activities.

In the pilot and air crew program, cadets study mathematics, navigation, signals, anti-gas measures, and armament. These studies are not theory but practical applications to aviation.

In the mechanic and ground-crew divisions, boys are trained by building furnishings and training equipment for the rest of the squadron. One A.T.C. squadron at Chesterfield has constructed a machine which corresponds to our Link Trainer. The chief difference is that the English Link Trainer cost about \$8 and was made from scrap.

Another important part of the program which all cadets must participate in is gunnery. It is also one of the most popular. Instruction and practice in firearms is given on the firing range.

The success of the A.T.C. in England and throughout the Empire training is already an established fact.

FIGHTER TACTICS

(CONTINUED FROM PAGE 9)

the first can be in position 1000 feet above, to dive again.

This method of formation interception is extremely effective. Recently in the Aleutians, an element of P-38's dove on a formation of Japanese bombers and knocked out four in a single attack, and escaped without being fired on by the escorting Zeros.

The heavier the armament of a fighter plane, the more deadly its use as a "destroyer." The more guns a fighter squadron can bring to bear on the enemy, the better the chance of swift victory.

Twelve Spitfire Mark 5s as flown by the U. S. Army Air Force pilots over Europe collectively carry an overwhelming fire power. These machines, diving in V three formation arranged in echelon, could turn 144 machine guns or 48 20 mm. cannon on enemy planes. Experts consider that the impact of the shell and bullet capacity of one of these fighters in a single second is equal to that of a ten-ton truck hitting a brick wall at 60 miles an hour. This gives you an idea of the terrific offensive weapon with which a fighter squadron is equipped.

Modern fighter tactics differ from those of the last war in various ways. Previously, light manoeuverable planes could tight turn in a circle of fifty yards. Today with their speed increased to over 400 mph. and their weight up in the 9000-pound class the aircraft need a mile or even more to execute their manoeuvers. In the last war while many actions were fought between fighter (or scout) planes of both sides, today fighters do not voluntarily mix it with fighters. The German pilots faced with a defensive war in Europe, Africa and elsewhere, take evasive action when they see the United Nations fighter squadrons. Only when protecting bombers do fighter pilots voluntarily attack enemy fighters. War is a science. Every weapon has its set purpose. Downing a bomber does more damage than shattering a fighter. To send a highly trained pilot in a costly airplane to duel with another pilot similarly equipped is not worthwhile. Reports of conflicts between fighters of both sides often show an even box score, because modern pilots are rather like heavyweight boxers. Each has a knock-out punch. The one who delivers it first wins.

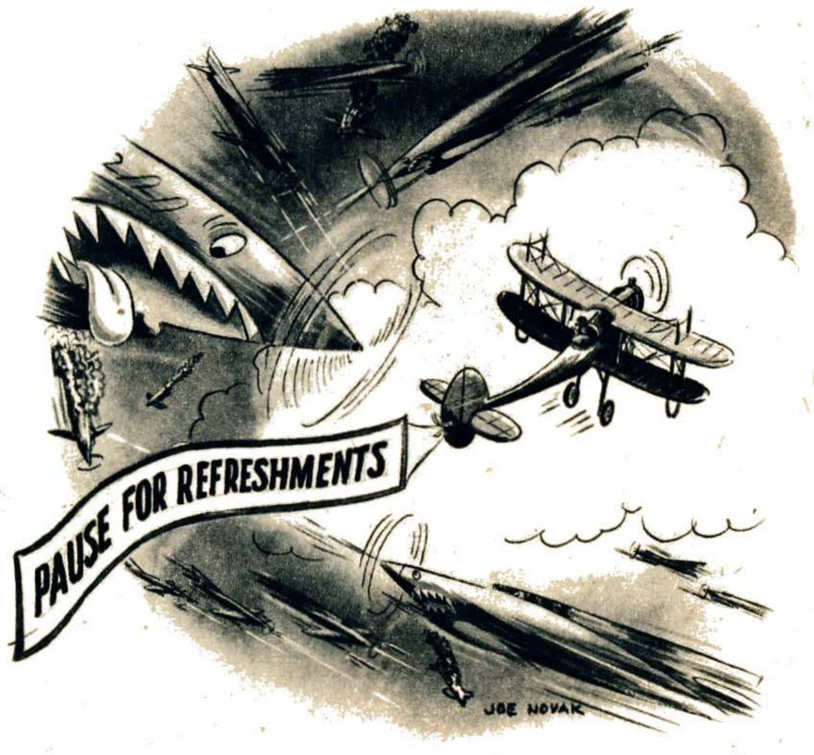
During the Battle of Britain, the first great air battle of the war when the present methods of fighter attack were developed, the faster Spitfires and the more manoeuverable Hurricanes were expertly handled by the British Fighter Command.

The huge losses inflicted on the enemy were due to surprise tactics, superior fire power and superb discipline. Reporting an action, an R.A.F. Squadron Leader described how his squadron attacked thirty Heinkel bombers supported by 30 ME-109s above them and 20 ME-110's below. "We turned and climbed," he says, "flying in the same direction as the sun, the whole squadron stringing out in echelon with the sun behind us, thus giving us a good view of the enemy. 'A flight' timed its attack to perfection, coming down from out of the sun in a power dive on the enemy's *left* flank. As each pilot selected his own target, the ME-110s roared in to intercept with cannons blazing at 1000 yards range. They were seconds too late to engage our fighters. As they flashed out of sight 'B flight' went into the attack. Then the Heinkels did an unbelievable thing. They turned south into the sun (the German pilots probably wanted to bring their fixed guns into action). With his first burst 'B flight' leader destroyed the leading bomber, which blew up with such force that it destroyed the bomber on its left. A short bank and the leader's second burst shot the right hand Heinkel out of formation. Another burst knocked down a ME-109 that came to attack him. Four aircraft destroyed for an expenditure of 1,200 rounds entirely justified our new tactics" comments the speaker.

Again and again the R.A.F. pilots, always working as teams, produced new tactics. One was a head-on attack—generally considered risky because of the danger of the enemy's fixed guns. The Hurricane pilots flew dead into the V head of a formation, to dive underneath and come up behind shooting down the rear lefthand aircraft of the formation. Then going up into a loop, the pilot would half roll, and give a burst at the middle bomber of the last V of three, and then as he turned away to starboard he gave his final burst to the outside rear plane, thus destroying three machines without a single scratch.

It would never do for a fighter squadron to use the same attack in every action. The enemy would set a trap and wipe it out. Each squadron has a number of attack plans, with variations, and Squadron Leaders are always evolving new tactics. Each tactic has the same intention, to get in close enough to the enemy airplane to inflict a fatal blow. That is the fighter pilot's job.

EDITOR'S NOTE. This article is the first of a series written for Flying Cadet by Keith Ayling. If you have enjoyed reading it, please let us know.



FLY LEAVES

MOST exciting new book on the aviation shelves in 1943 is the big and beautiful AIR NEWS YEARBOOK—264 pages which picture and analyze the military aircraft of the world. The volume was compiled and edited by Phillip Andrews, Air News publisher. Included are many heretofore unpublished views of American, Allied and Axis planes, with their photographic qualities accentuated by lavish use of space and excellent sheet-fed gravure reproduction. All pictures are thoroughly documented and the air power of each nation is summarized in forewords which precede each chapter. Published by Duell, Sloan and Pearce. Available at all bookstores or directly from Air News, 545 Fifth Avenue, New York, at $3.75, postage prepaid.

AIRCRAFT CARRIER

Lieutenant Bob Winston, U.S.N., author of best-selling DIVE BOMBER and ACES WILD, has written a story of the aircraft carrier and the important part it has played, and is playing in the naval struggle in the Pacific. Included are a few of the Navy's communiques issued following battles in which our ship-borne planes have participated, and more than a hundred below-deck, flight-deck and air-view photographs of carriers. AIRCRAFT CARRIER, by Lieutenant Robert A Winston, U.S.N., 88 pages, $2, published by Harper & Brothers, New York.

FIGHTER FACTS, FALLACIES

Every airplane represents a series of compromises in the eyes of the engineer. When great range is obtained, speed and maneuverability suffer. In the same way, the improvement in one quality causes some other quality to suffer. This story of compromise is told expertly in FIGHTER FACTS AND FALLACIES by John G. Lee. Illustrated by diagrams and drawings. Introduction by Professor Jerome C. Hunsaker. 63 pages. $1.25. William Morrow and Co., New York.

WINGS FOR OFFENSE

WINGS FOR OFFENSE by Captain Burr Leyson is a review of the machinery of American air power; the planes and methods employed in combat; the training of pilots and crewmen; the research, design and manufacture of engines and planes; and ground defenses. 218 pages. $2.50. E. P. Dutton and Co., New York.

THE FLYING TIGERS

THE FLYING TIGERS by Russell Whelan is a complete and thoroughly authenticated account of the up-hill fight of those Americans under the leadership of Claire Chenneault who blasted the Japs out of the Burma skies. Complete organization names and details. Many photographs. 224 pages. $2.50. The Viking Press, New York.

AVIATION MATH.

AVIATION MATHEMATICS. Based on a text used for training R.A.F. pilots and members of the British Air Training Corps, prepared by William R. Wadden of Rindge Technical School, Cambridge, Mass. and checked by Lieutenant Commander James G. Willet, U.S.N. Arithmetic, algebra, geometry, graphs, compass, trangles of velocities, logarithms, trigonometry, practice tests, selected problems, tables. 136 pages. $1.25. Houghton Mifflin Co., New York.

RANDOLPH FIELD

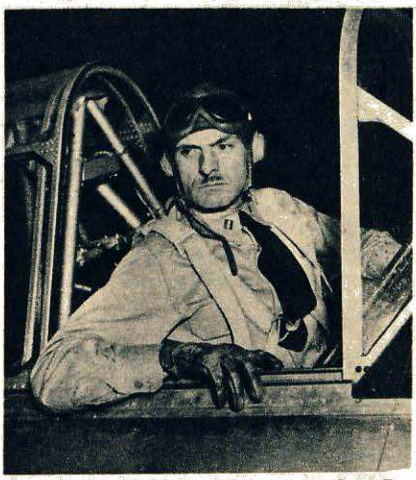
RANDOLPH FIELD by the Texas WPA Writers' Project is a well-illustrated and ably presented story of that basic training school outside San Antonio which has been called the "West Point of the Air" Cadet routine, organization, facilities, instructor staff. 155 pages. $2. Devin-Adair Co., New York.

CLOUDS, AIR, WIND

There are many things to learn about meteorology but there is probably no way of grasping the fundamentals more clearly and quickly than in the pictorial pages which have been developed with great craftsmanship by Eric Sloane. CLOUDS, AIR AND WIND contains many full-page reproductions of cloudscapes, through which military planes are driving or diving. The pictures are used to illustrate the characteristics of cloud forms, and each is thoroughly described. While about half of the book is devoted to cloudscapes, there is a great amount of information to be obtained from full-page sketches and explanations of instruments used by the meteorologist, of cloudbirth, anatomy of the air, air currents, wind, the summer storm, the winter storm, the dangers of weather in flying, how to read a weather map, the principles of soaring, and weather magic. CLOUDS, AIR AND WIND is recommended for all student airmen, published at $3 by Devin-Adair Co., 23 E. 26th St., New York.

FLYING CADET BY-LINES

ONE by one, month after month, this column will present the writing staff of FLYING CADET. First up is Lieutenant Ernest G. Vetter, U.S.N.R., who starts in this issue a series of articles on meteorology. Now being transferred to Purdue University to organize a school of naval aviation instructors, Lieutenant Vetter was until recently executive officer of the Naval Reserve Aviation Base at New Orleans, in charge of all student activities.



Lieut. Ernest G. Vetter, U.S.N.R.

Taught to fly in 1929 by E. A. Link, Jr., inventor of the Link Trainer, Lieutenant Vetter has, ever since then, been engaged in the operation of aircraft, instruction of flyers and the writing of magazine articles and books. He was flight and ground instructor at Buffalo Airport and president of the Western New York Flying Club. Before being called to Pensacola for active duty as a flight instructor in 1940, he was private flying specialist of the Civil Aeronautics Administration. His books "Aeronautics Simplified," "Let's Fly" and "Visibility Unlimited" have been widely circulated and have earned him a place in "Who's Who in America," "Who's Who in Aviation" and "Who's Who in North American Authors."

CADET QUIZ ANSWERS

Answers to Questions on Pages 40-41

A. An omelet and bread and butter.

B. An amphibian plane, convoying a fishing fleet, spotted a submarine.

C. Following the course of a river.

D. A target made of cloth which is towed by one plane for a gunner in a second plane.

E. A Chicago piano is Navy vernacular for a multiple anti-aircraft gun.

The Georgia mosquito is a thoroughly annoying insect to have around. So is the Stuka dive-bomber which has been given its name.

1. A pursuit pilot. A pea-shooter is a pursuit plane.

2. No. He depends upon centrifugal force. The classic example of the operation of this force is the swinging of a pail of water in a vertical arc. If it swings fast enough, the water does not spill. Similarly, if the speed of the plane is correct, the pilot has no tendency to spill. Thus his safety belt at that time is of no use to him.

3. The rear gunner in a bombing plane.

4. Hornet.

5. July 4.

6. The B-24.

7. The parachute jumper—the boy who sings "life won't mean a thing if you don't pull that ring."

8. TBF Avenger. PBY Catalina. F4F Wildcat.

9. An airplane mechanic. Dollies are wheeled platforms used for shifting planes from one place to another. Doilies are pieces of dirty, oily waste. Aprons are the paved strips on airfields where planes are warmed up and serviced before take-offs.

10. An inelegant term sometimes used to describe airline stewardesses.

11. Number 2. An undue increase in self-confidence is a characteristic symptom of oxygen starvation.

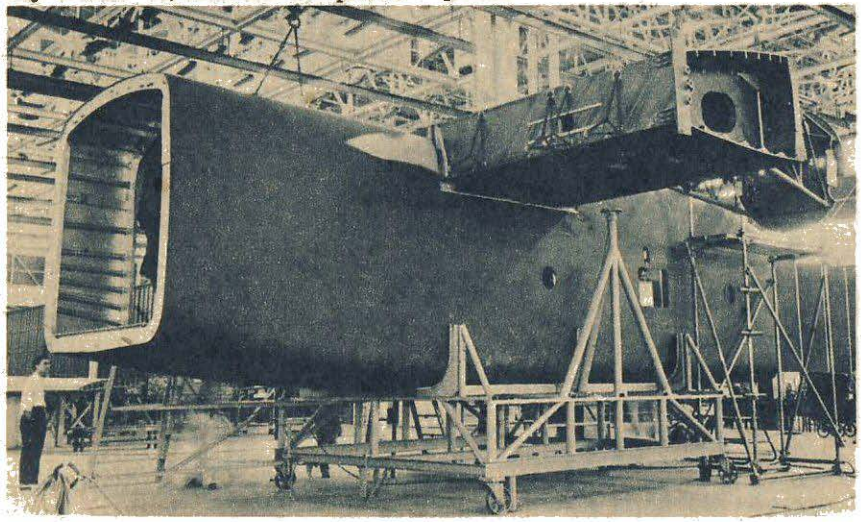
12. The airport manager inspects the practice plane.

13. Because one ship following directly behind another would get into the first plane's propeller wash or slipstream and its flight consequently would be disturbed. Each plane in string formation thus flies, as a rule, a little above or below the true line of flight of the ship preceding it.

14. Flak.

15. The tail assembly of an airplane.

BAD NEWS FOR SUBS. This is the first picture released by the Navy showing the huge production of 24-ton "Mariner" patrol bombers on extensive assembly line at the Glenn L. Martin Co. plant in Baltimore.



First photo of the huge Curtiss Caravan, box-car of the air

AIRPLANE IDENTIFICATIONS

Answers to Questions on Page 33

1A Hawker Hurricane, powered by a 1260 horsepower Rolls-Royce Merlin engine. Armed with four 20-mm cannon.

1B Messerschmitt 109-F, powered by a 1175 horsepower Daimler-Benz liquid-cooled engine. Capable of 400 mph. Has one 20-mm cannon and two machine guns.

2B Russian TB-7 mid-wing, four engine bomber.

2A German Focke-Wulf Kurier used for attacking convoys.

3A Mitsubishi T97-1 Kamikazi low-wing monoplane, 900 hp. engine.

3B Douglas TBD Devastator. One of the Navy's famous torpedo planes.

4A Junkers JU-52-3M. German parachute-troop carrier.

4B Curtiss C-46 Commando.

5A Messerschmitt ME 110

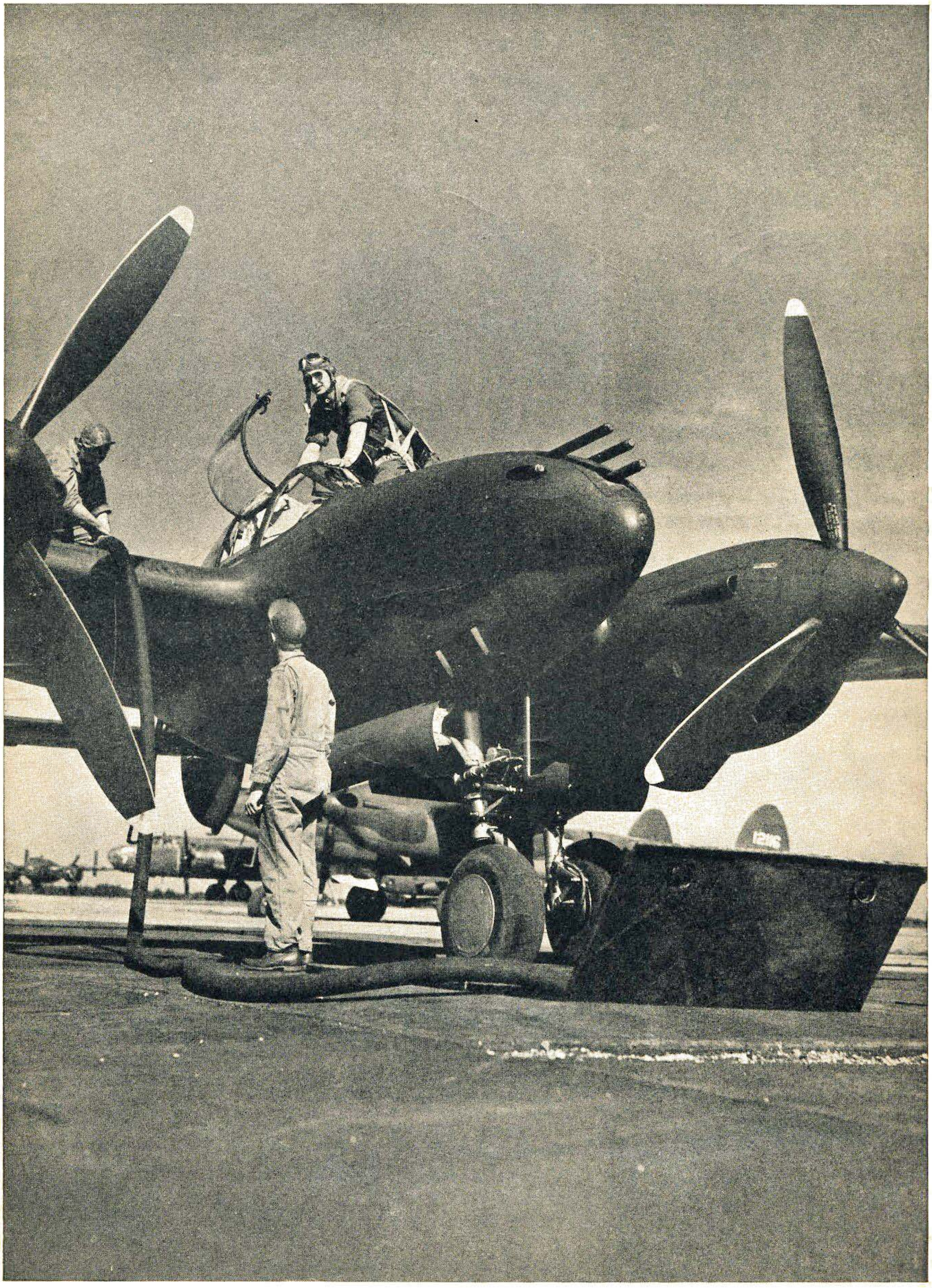
5B North American B-25. The plane which attacked Tokyo.

6A Britain's Avro Lancaster four-engine heavy bomber.

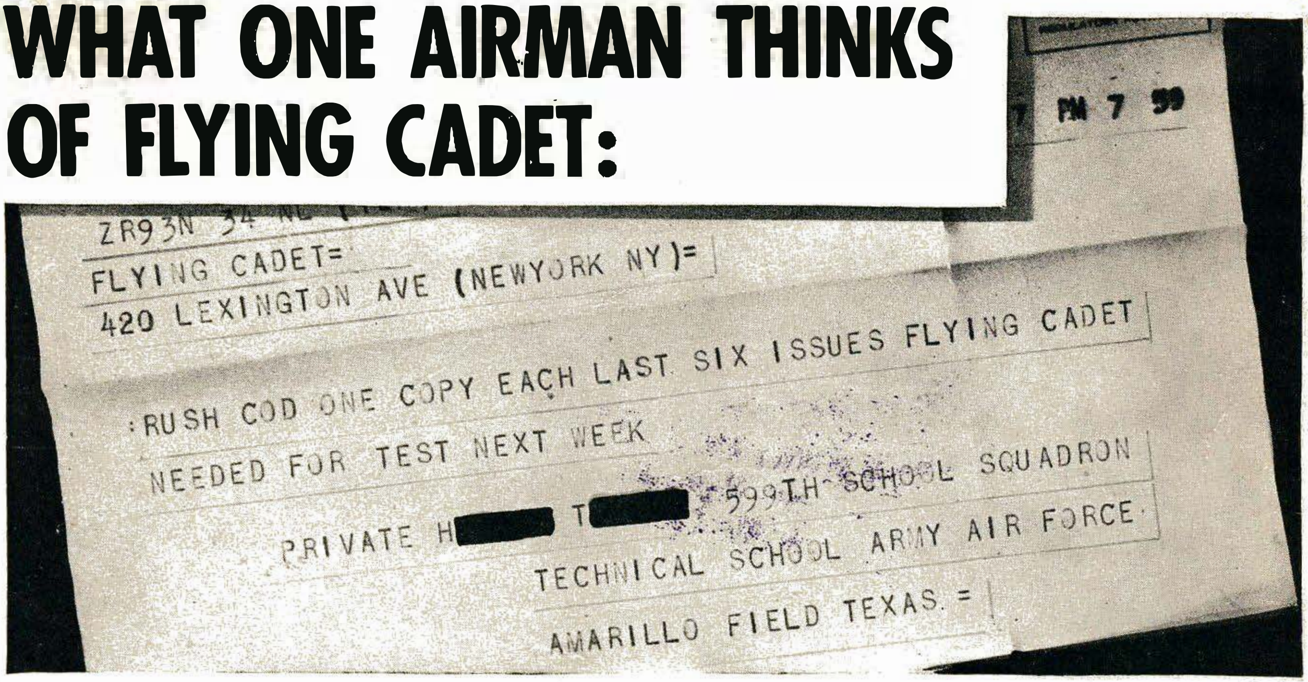
6B Germany's Blohm &. Voss 142 inverted-gull-wing bomber.

COVER PICTURES

Inside the front cover of this issue of Flying Cadet is a picture of the Vought Sikorsky F4U-1, or the Corsair, which is described by many experts as the fastest and most powerful shipboard fighter in the world. It is powered with a 2,200 horsepower Pratt & Whitney Double Wasp aircooled radial engine. Inside the back cover is an Army Lockheed Lightning P-38 being refueled. Lockheed P-38s are seeing service now on the front in Tunis.



WHAT ONE AIRMAN THINKS OF FLYING CADET: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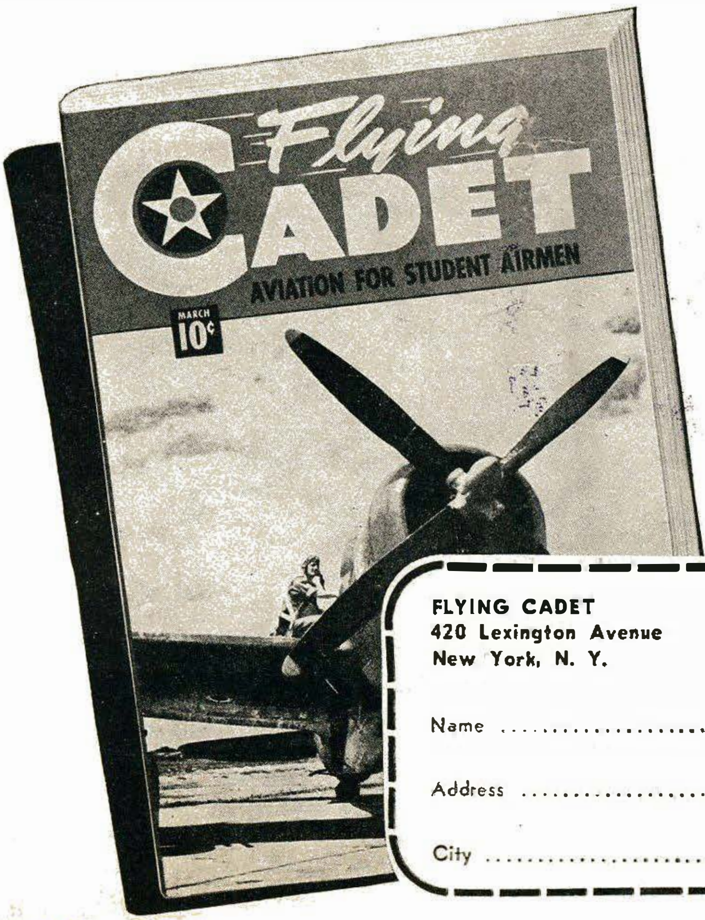

No other aviation magazine gives you everything you get in Flying Cadet—news right off the firing line, thrilling aviation accounts of U. S. pilots, bombardiers, and gunners in World War II. Flying Cadet has been written for student pilots and will keep you up to date on everything that is new in aviation. It will tell you what you ought to know about navigation, meteorology, aerodynamics, aviation construction and design —all in easily understood language, profusely illustrated with drawings, pictures, diagrams and blueprints. Subscribe to Flying Cadet at once. Clip and mail the coupon below. Do it right away so that you will not miss a single issue. Twelve issues by mail anywhere in the U. S., $1.00. Elsewhere, $1.50 in U. S. currency.

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