AIRFARE
OF TO-DAY AND OF THE FUTURE

EDGAR C. MIDDLETON

AIRFARE

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A "LINE" OF BRITISH FIGHTING SCOUTS

By permission of Whitehead Aircraft, Ltd., Richmond

Frontispiece

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BY

EDGAR C. MIDDLETON

LATE FLIGHT SUB-LIEUT. R.N.
"AN AIR PILOT"
HOLDER OF ROYAL AERO CLUB CERTIFICATE
AUTHOR OF "AIRCRAFT," "THE WAY OF THE AIR"
AND "GLORIOUS EXPLOITS OF THE AIR"

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TO MOTHER

A HUMBLE APPRECIATION

AUTHOR'S NOTE

WITH Aviation we may say that we have reached the fifth step in the cycle of world progression. The exploration and the mastery of the seas opened up a hitherto unknown world to the peoples of the Middle Ages. Later the development of the steam engine pushed on civilization and commerce apace. After came the steamer upon the seas. Electricity gave the world a new and far-reaching motive power, and almost entirely replaced manual labour. But the advent of Aviation changed for all time the conditions of the world. As a factor of war it revolutionized every military principle and theory. As vessels of commerce, aircraft will have reduced time to a minimum, and rendered distance almost oblivious; bringing every far corner of the earth within easy reach of the more populous centres. So much has already been accomplished in ten years, that one dare hardly predict what the future holds in store.

I would like to take this opportunity of thanking the Editors of the *Daily Mail*, *Daily Express*, *Evening Standard* and *Flying* for their courtesy in permitting me to use, in a few instances, material embodied in articles appearing in their journals; also the courteous privileges extended to me by J. A. Whitehead, Esq., of the Whitehead Aircraft Co., Ltd., Richmond, in gathering necessary material.

EDGAR C. MIDDLETON

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AERIAL DICTIONARY

(SLANG AND TECHNOLOGY)

Angle of Incidence (*The*).—The angle a wing makes with the direction of motion relative to the air.

Ballonet (*A*).—An air-bag within the gas-container of a balloon or an airship. Its function is to control the pressure of the gas.

Bank a Machine (*To*).—To lower the inner wing, to counteract the centrifugal force of the machine.

Body or Fuselage (*The*).—The main portion of the craft, which contains the engine, pilot and observer's seats, and the fuel tanks.

Bump (*A*).—A point where two currents of air conflict.

Bus (*A*).—Pilot's slang for an aeroplane.

Chassis.—The under-carriage.

Control Lever (*The*).—The lever that manœuvres both ailerons, wings, and elevators.

Drift (*The*).—Of an aircraft is the distance by which the craft is carried out of its course (drifted) by an air-current.

Elevator (*The*).—Is used for steering and balancing in the up and down directions.

Gadget (*A*).—Popular aeronautical term for varied appliances, great and small.

Gasbag (*A*).—Every aeroplane pilot refers contemptuously to airships as gasbags.

Glide (*To*).—Is to descend with the engine cut off.

Gun-bus (*A*).—A fighting aeroplane.

Head-resistance (*The*).—The total resistance in the line of motion.

Hun (*A*).—The Royal Flying Corps term for a beginner.

Joy-ride (*A*).—A trip up aloft is invariably referred to as a joy-ride.

Joy-stick (*The*).—The air-pilot's slang for the control lever.

Lift.—A matter of varying pressures on given surfaces.

Nose-dive (*To*).—When the craft is descending in a vertical direction to the earth.

Pancake (*To*).—Is for the craft to fall flat to the ground.

Prop (*The*).—Abbreviation for propeller.

Pusher Aeroplane (*A*).—With the engine and propeller at the rear.

Pylon-Pilot (*A*).—A gentleman who is biassed in the matter of preferring a large and admiring audience to fly over.

Quirk (*A*).—R.N.A.S. term for a beginner.

Sausage (*The*).—Slang for a kite balloon.

Screw (*The*).—Of a seaplane is the slang for propeller.

Side-Slip (*A*).—Meaning obvious—slipping inward of the craft.

Skidding.—Slipping outward of the craft.

Spin (*A*).—The most unpleasant sensation possible in mid-air. It usually occurs after over-banking, with the result that the aeroplane spins round like a top, and finally, nose-diving, crashes to earth.

Streamline.—A certain definite shape on the plan of which all aeroplanes are constructed. This plan allows the lines of the craft to follow the direction of the currents of air caused by the head-resistance.

Stunt (*A*).—Any trick in the air.

Tractor Aeroplane (*A*).—With the engine and propeller to the fore.

Undercarriage.—The framework beneath the body of the craft. It serves both the purposes of landing and of absorbing the shock thus caused.

Volplané.—To glide.

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AIRFARE

OF TO-DAY AND OF THE FUTURE

CHAPTER I

THE NAVIGATION OF THE AIR

The Surface of the Earth

A MAP of the surface of the earth is to many people hardly more distinguishable than a Chinese love-letter or the American Morse Code. The markings are crudely unmistakable; but a maze of colours and angles and shapes. Yet this same evil contraption, given the geographical position of the North, and a distinguishable point on the surface of the earth, is simple to read as an open book. With the airman, however, the angle of perspective is different and certainly more bewildering. He has no single point but the entire earth at his feet, stretching away to the oblivion of the sky-line in the direction of every point of the compass. The general position is harder to grasp, and map making and reading form no small part in the curriculum of his education. While navigation is as important to him as it is to the sailor.

There is much in common between sea and air. The elements are similar. The traditions and

precedents of the older Service will, in time, apply equally to either.

With regard to navigation and pilotage the main differences are: whereas the view of the sea navigator is on the level, that of his brother of the air lies always below and covers an extremely wide area.

What does the surface of the earth look like viewed from above? The first view over the side is both curious and bewildering. It is a Lilliputian world, over which swarm numerous ant-like figures. It is pleasing to the eye; a regular, unorthodox riot of colours. The colour scheme strikes one more than any other element. The grouping of towns and cities, villages and hamlets is peculiar. The roads and railways in the more populous districts intermingle in puzzling fashion. Naturally the sharpest division is that between land and sea. The blue of the one borders the grey of the other, with a thin dividing line of yellow sand of the foreshore. This yellow on the sea fringe is conspicuous: and from a certain altitude over the sea the bed is thrown up in bold relief.

These details are all supplied in the contour maps. But the map to the airman is more than a voiceless jumble of shapes and colours. It bespeaks a glorious panorama of brown-smudged altitudes, blue-lined rivers, green-tinted plains, grey-blotted towns and villages, straight, black-lined railways, that are criss-crossed into squares to be criss-crossed again, and given ugly appellations as Ac 31, Df 22, maps that are to be read only by compass and by scale.

Piecing together the intermediate colours in the grey background of the land, we have, most conspicuous, the blue of the rivers and lakes. As landmarks they are the most easily distinguishable,

excepting in wet weather, when they overflow their banks and change materially the appearance of the country for miles around. Next in order of importance are railway-tracks, distinguishable by reason of their regularity and directness; they connect up the principal centres of population like network. Tunnels are at times apt to be disconcerting. The track will disappear from view for half a mile or so. But here again reference to the map soon enables the pilot to pick up the broken thread.

Large towns and populous districts are unmistakable. The key to their identity is the plan of the diverging lines of roads, rivers and railways.

Passing to the open country, woods are conspicuous, but above an altitude of 2500 they present the surface of a level meadowland. Fields of crops differ in shade with the varying seasons of the year. Wheat in summer presents a golden-yellow appearance; in autumn, brown; in spring, green. Stubble fields are lightish brown in appearance, and dark green fields are usually found to be roots.

Roads follow almost exactly the system of railways. First-class or main roads are easily distinguishable from their width, the blue steelish appearance of their surface, and the lines of telegraph and telephone wires along either side. The old Roman roads in England are most easily distinguishable by reason of their directness. Among other conspicuous objects are golf-links; the greens and the yellow sand-bunkers stand out prominently, and glass-houses that glitter dazzlingly in the sun.

Above an altitude of two thousand five hundred and three thousand feet the entire surface of the earth, hill and valley, wood and field, appear to be at the same level. Landmarks are most difficult to distinguish when flying either at an extremely low or extremely high altitude. The time on sunny,

cloudless days passes with great rapidity; in dull, cloudy weather it drags, until the seconds seem minutes, and the minutes hours. The natural course of the machine is never a direct one. It is apt, first, to veer to the left, then to return to the direct course, and then branch off again to the right.

Factory chimneys and railway locomotives are useful to the air pilot. Their smoke indicates the direction of the prevailing wind, so necessary in the matter of landing the aeroplane, which must be performed head against the wind, as also getting off from the ground.

The difficulty of aerial navigation may be gauged from the fact that a pilot recently lost his way when flying between Hendon and Chingford. Another affair of the same kind was the cause of numerous questions in the House of Commons, and concerned an aeroplane of the latest type that had been flown across Channel to the firing-line, and landed in the enemy's country on its first trip. A German pilot, in similar fashion, flew down the Belgian coast, and landed at Calais in mistake for Ostend, there to be promptly made a prisoner. And yet another instance is on record of an R.F.C. pilot who, setting out one fine morning from somewhere in Kent, ran into a dense bank of fog, and eventually landed in Norfolk. Unaccustomed to the broad dialect of the natives, he imagined for the moment that he had found his way across Channel and landed in the German lines, and was about to set fire to his machine when he discovered his happy mistake.

The majority of these errors can be avoided by reference to the map and the use of the altimeter, another name for which is the statoscope. This instrument is contained in a large metal case and registers the altitude in hundreds of feet. Beneath

the face is an opening, into which is fitted a taut rubber membrane, with a small rubber tube leading to the outer air. By pinching the latter between the fingers, the outer air is excluded from the membrane. When the craft ascends, the air in the statoscope will expand, when it descends it will contract. Contraction or expansion both react on the rubber membrane, which will be sucked inward in descending, and when ascending be blown outwards. By means of delicate internal machinery these movements are conveyed to the indicator hand on the disc. But the altimeter only registers height above sea-level.

Thus an airman setting off from an aerodrome that lies some 2000 feet above the level of the sea, would fly on with the altimeter registering, let us say, four thousand feet; yet in reality he would only be two thousand above the level of the land, and in constant danger of collision with altitudes on the surface of over two thousand feet.

The matter of altitude varies considerably with the nature of the flying. For war work, usually well over 8000; for commercial purposes, anything from between 2000 to 6000 feet. The greater the altitude the safer is the flying. The engine of a machine failing at a height of 8000 leaves the pilot a radius of, roughly, ten square miles in which to choose a landing-place; at 9000, twelve square miles; and at 10,000 ten, and so forth.

A comparison between the altitudes of the highest mountain peaks of the world and flying offers matter for interesting thought. We discover that the war altitude of flying ranges from the height of the Catskill Mountains to the peak of Teneriffe, and that the crest of Mount Everest is double the height of the present-day flying altitude. We have no great mountains in this country, but the hills tower

sufficiently to form a continual danger to passing aircraft. No doubt in time to come such danger spots will be topped by aerial lighthouses and beacons.

Contour, from the airman's point of view, is the important characteristic of the map.

A map after the style of the Mercator's Chart would be an ideal map for the air. It would be constructed on the following principle. The Rhumb

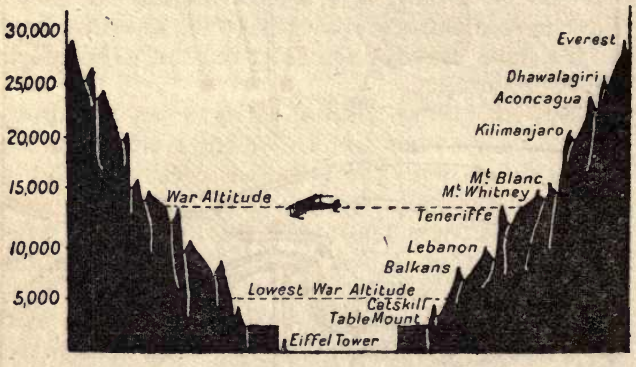


FIG. 1. A COMPARISON OF FLYING HEIGHTS

lines on the earth's surface would be represented by straight lines on the chart. And angles on the earth's surface would be equal to the corresponding angles on the chart. The only markings would be contour, roads, railways, rivers, and towns.

A map of London on this principle would appear after the fashion of Fig. 2.

Laws of the Air

Naturally so vast an area as the air calls for special regulations and laws. And as long since as 1902 a conference of balloonists met at Brussels.

The meeting devoted the better part of the time to discussing the differences between military and civilian types of craft, the use of a distinguishing flag for each craft, and the organization of the lately formed Fédération Aéronautique Internationale, a body that now governs aeronautical matters of

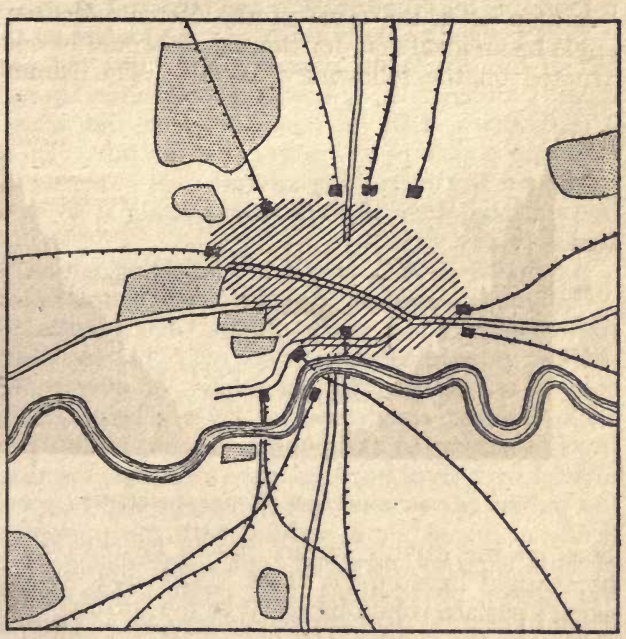


FIG. 2. HOW LONDON APPEARS FROM ABOVE

almost every nation of the world, and to which is affiliated our Royal Aero Club.

The latter institution has been instrumental in drawing up various rules and regulations regarding flying in Great Britain, the majority of them as a safeguard to the aviator himself. For instance, to avoid collision in mid-air: "Two aircraft meeting

each other, end on, and thereby running the risk of a collision, must always steer to the right. They must, in addition to this, pass at a distance of at least 100 metres, taken between their nearest adjacent points.

"Any aircraft overtaking another aircraft is responsible for keeping clear, and must not approach within 100 metres on the right, or 300 metres on the left of the overtaken aircraft; and must not pass directly underneath, or over, such overtaken aircraft. The distance shall be taken between the nearest adjacent points of the respective aircraft. In no case must the overtaking aircraft turn in across the bows of the other aircraft after passing it so as to foul it in any way."

Again, the R.A.C. issued the following notice:—

"Flying to the danger of the public is prohibited, particularly unnecessary flights over towns or thickly populated areas, or over places where crowds are temporarily assembled, or over public enclosures, or aerodromes at such a height as to involve danger to the public. Flying is also prohibited over river regattas, race meetings, meetings for public games and sports, except flights specifically arranged for in writing with the promoters of such regattas, meetings, etc. Any disregard of the above prohibitions will render the aviator liable to censure, fine not exceeding £20, suspension of the competitor's certificate, and removal from the competitors' register."

In 1913 the Government passed the Aerial Navigation Act, that dealt with the specified areas over which the navigation of "every class and description of aircraft" was prohibited. These areas comprised dockyards, fortresses, arsenals, harbours and barracks.

"No aircraft from abroad is allowed to make a

landing in this country, except in special areas. The person in charge of such aircraft must be in possession of a clearance of a British consular officer from the country in which the voyage was commenced.

"No person in any aircraft entering the United Kingdom shall carry or allow to be carried in the aircraft (*a*) Any goods, the importation of which is prohibited by the law relating to customs. (*b*) Any goods chargeable upon importation into the United Kingdom with any duty of Customs, except such small quantities as have been placed on board at the place of departure as being necessary for the use during the voyage of the persons conveyed therein. (*c*) Any photographic apparatus, carrier or homing pigeons, explosives or fire-arms; and (*d*) Any mails.

"The person in charge of the aircraft shall not continue his voyage until he has obtained a permit from the authorized officer, for which a fee of £3 will be payable in the case of an airship and £1 in case of an aeroplane.

"Foreign naval or military aircraft shall not pass over or land within any part of the United Kingdom or the territorial waters thereof except on the express invitation, or with the express permission, previously obtained, of His Majesty's Government. Such aircraft shall enjoy such exemptions from the foregoing Orders and be subject to such special conditions as may be specified in the invitation or permission.

"Nothing in the foregoing Orders shall be construed as conferring on a person navigating an aircraft any right to land in any place as against the wishes of the owner of the land or other persons interested therein, or as affecting the rights or remedies of any person in respect of any injury to persons or property caused by any aircraft.

"Any person navigating an aircraft in contravention of the foregoing Orders is liable on conviction to imprisonment for six months or to a fine of £200, or to both imprisonment and fine."

Navigation and Pilotage

Of the various zones, tropical and sub-tropical lend themselves more easily to aviation. The explanation is that the weather there is more reliable. The various seasons are more sharply defined. There is no unpleasant intermingling of calm and stormy weather. To a degree one may be certain twenty-four hours previous what the weather conditions promise to be. And the tepid air is favourable to aviation, never the warmest of professions.

Per contra the difficulties encountered in a temperate zone, as the one within which this country lies, are enormous. Rain, sun, snow, fog, all are possible within the incredibly short space of twenty-four hours. For days on end flying will be impossible, and the pilot thus kept idle and useless.

Closely akin to this matter of weather is the contrast between night and day flying. It is common knowledge that flying is mostly confined to daylight. The darkness holds many different dangers and terrors. First, the surface of the earth is lost to view. This intensifies the dangers of landing, always a hazardous enterprise. To some extent this difficulty is overcome by the use of landing flares, which in a darkened country stand out with prominence. The most favourable of these night-lighting schemes is that recently adopted by the enemy.

A large white light is placed in the centre of the landing-ground, sunk into a trench in the ground

and covered with thick glass to withstand the weight of an aeroplane. At a distance of about 250 feet from this light, and also sunk into the ground, are four red lights corresponding to the cardinal points of the compass. Each of the red lights is connected by subterranean cables to a wind-vane, mounted on a mast or tower at some convenient point. At night the central light glows constantly, while the red light in the direction of the wind indicates to the pilot the wind conditions where the landing is to be made. It is understood that a system of altering the lights has been devised, so that an aviator must understand the code in order to know his whereabouts. Thus enemy airmen are prevented from using the lights as guides.

Another method is to extinguish the lights immediately the pilot has left the ground and wait for his return signal before relighting them. This signalling is performed by firing a bullet of a certain colour from a Very's pistol at a low altitude.

However, night flying is an art in itself, and is only permitted to experienced pilots; the principal reason being, as previously mentioned, that darkness obliterates all landmarks, which brings us to the matter of pilotage and navigation.

The former is accomplished by the aid of landmarks and the map; a compass is unnecessary. On the other hand, navigation is steering a course out of sight of landmarks by compass. And though the compass is said to be the best friend of the sailor, yet more so is it of the airman.

It is a similar instrument to that employed on a ship. The variation—that changes slightly every year—is similar; also the deviation—this latter being a matter to do with the metal in the framework and the engine of the machine, which is in

manner similar to the natural magnetism in the earth that causes the variation of the compass needle from true to the magnetic north. Deviation again varies the compass further from the true north, and is compensated for by the arrangement of certain magnets that draw the needle back to the correct position.

Later we learn, *vide* the *Scientific American*, of the invention of an airman's compass which is visible at night by its own light. With this compass "a knowledge of navigation is not essential for laying a course. The first step is to set the instrument upon the chart at the spot indicating the user's location. The zero mounting of the outer ring, in line with the arrow point on the glass crystal, should point toward the north or top of the map. Any course desired (or the direction to be travelled in going from one location to another) may be found by elevating, to an angle of 45 degrees, the arm of metal attached to the outer ring and then sighting over its top and the niche in the magnifying glass bezel ring to a pin stuck in the chart at the point of destination. Such a process illustrates one important advantage of this compass over similar instruments, namely, that parallel rules for sighting are unnecessary and may be dispensed with.

"In order to travel from any location to a particular destination it is essential to apply the magnetic variation. With other compasses it is necessary to add or subtract this magnetic difference, depending upon whether the variation is westerly or easterly. Doing so gives the magnetic head to be travelled, read on the centre dial in the bowl. In using this compass, however, both adding and substracting are done away with. It is merely necessary to move the lubber's line, indicated by a white line and

arrow painted on the crystal, to the point of destination. This line becomes the lubber's line to be followed in actual travel.

"The present compass, measuring an inch and a quarter thick and two and three-quarter inches in diameter, contains no steel except that in the magnet, so the needle cannot become deranged by being attracted to another part of the compass. The bowl is made of bronze and painted, while the fittings are of brass. A magnifying glass, mounted in the bezel ring and fitted over the dial, enlarges the figures on the latter so that they may be read more easily. A nickel ring attached to the outside of the bowl is for convenience in carrying the instrument with a strap, if desired.

"To increase the accuracy of this compass, the card is mounted in a mixture of alcohol and distilled water, thus rendering the magnetic float more buoyant and sensitive. The markings on this compass are readable at night in the light from the radium dial, which is graduated every 5 degrees and numbered every 20 degrees. The last zero is omitted in all numbers to avoid crowding."

Another deterrent to flying an accurate course are cross-currents of air. To avoid this difficulty, it is usual for the pilot to plot out a true course by mathematics preparatory to leaving the ground, making due allowance for the cross-currents and the mileage. Inappropriate word! Despite the fact that aerial is so remarkably similar to sea navigation, the R.F.C. still persist in talking of flying at so many miles an hour. How much better it would sound than saying: an aeroplane was making fifty miles an hour, to say, it was making forty-five knots —never knots an hour. A knot is equivalent, roughly, to 6080 feet or 2026 yards.

So much for to-day. In the future, within the

space of a very few years we will find beaten tracks in the air as to-day they lie across the great oceans. There will be special trade routes and commercial tracks. But they will, without exception, all lie eastward of the United Kingdom.

CHAPTER II

CLIMATIC AND GEOGRAPHICAL CONDITIONS

AVIATION develops more and more day by day. To the uninitiated such development is regarded with interest, but not appreciation. This by reason of the strenuous times in which we live, and the necessary military secrecy which prohibits public discussion concerning the development of the various craft. To the man in the street aviation provides a pleasing interlude to the grim chorus of war. It is spectacular, thrilling, heroic! Beyond that it is not realized that the aeroplane and airship are no longer units but decisive factors in battle. Yet the air is common to all. To every Power that has the necessary craft it provides a free highway, for good or evil. And what is common to all cannot be held by all. One alone can control. In time past it was the sea that was the common element. From the time of the Roman Empire the dominating Powers of the world have held the sea before conquering the land, and, incidentally, been possessed of ample seaboards. Spain is witness to the latter fact, as also France, and later our own Empire. We mastered the sea: we mastered the world! Now the air, by reason of its accessibility, has superseded the sea. In the future, the mastery of the air must mean the dominion of the world.

But before further discussion it will be well to

consider the types of craft. They are three in number: aeroplane, seaplane, and airship. The former operates entirely over land; the seaplane, as its name would imply, over the sea; and the latter, over both land and sea. Which of the three offer greater possibilities in the future? For the nonce we will adopt the aeroplane, by reason of its already extensive field of operations.

Studying the map of the world, from the point of view of the air, what do we discover? Not five continents and five oceans, but one great tract of land that stretches from Hammerfest in the north to Capetown in the south, westward to Lisbon, eastward to Vladivostock, comprising three entire continents. For the rest the main group is surrounded by the great oceans, in which lie the distant continents of Australasia and America.

How does this redistribution affect Great Britain? Our islands will lie on the extreme western edge of civilization. No longer will the activities of the world turn on a hub so distant from the centre. No longer will this country be an island. For many years to come the uncertain climatic conditions of the Atlantic Ocean will protect our western shores. But to the east we shall be at the mercy of the world. In the future our lines of communication, our lines of supply, will all lie eastward.

To-day the radius of aircraft is roughly 150 miles, with airships 300. Already many of our cities, manufacturing centres, and positions of military importance lie within easy reach of Amsterdam, Paris, and Brussels. When that aeroplane radius extends to three, and the Zeppelin to 600, it will include Metz, Cologne, Bremen, Milan, Berne, Innsbruck, Vienna, Berlin, Hamburg, Copenhagen, Saragossa (Spain), Christiania, and Bergen (Norway).

World supremacy for us then will be mastery of

the air. Such mastery can only be achieved with an unceasing, unlimited supply of money and craft. And the future of aircraft lies in the hands of the constructors. Insufficient encouragement will entail the loss of valuable ideas and future prestige. With regard to the actual flying, aircraft are affected by climatic conditions even more than sea vessels. The latter have land-sheltered harbours to anchor from the gale. For the airman is no refuge. Inclement weather renders flying impossible.

Of all these elements, wind affects flying most. It is a matter to do with the speed of the craft over the surface of the earth. The speedometer of an aeroplane may register 80 m.p.h., but is influenced solely by the power of the engine. In reality the speed of that machine might be ten miles over the ground, that is to say it might be flying ten miles in a backward direction. The wind against which it is flying is one of ninety miles, or ten more per hour than its maximum speed.

Fog is a most dangerous condition to the airman. Once in a fog he loses all sense of direction and proportion. Earth and sky, and all landmarks are alike obliterated. Rain is blinding to the eyes, and affects the lift of the machine. And snow covers the surface of the earth with a treacherous regularity, rendering the landing of an aeroplane both dangerous and difficult.

But perhaps the most curious phenomenon of the air is the "bump" that causes the aeroplane to toss and heave like a boat in a stormy sea, and sends it plunging downward, sometimes as much as 200 feet. These bumps are caused by diverging currents of air. It is not generally known that there are currents in the air, just as there are currents in the sea. The explanation of the cause is simple. The night is always cooler than the day, but the

earth retains more of its warmth than does the air. The latter, by the morning, in spring, summer and autumn is quite chilly, in winter icy cold. When the sun rises the rays beat down upon the earth, warming perceptibly the strata of air through which they pass. The earth is more quickly warmed, and the heat which it irradiates warms the layer of air immediately above it.

This hot air commences to expand and rises, forming a vertical column of warm air which, forcing its way upwards, meets with considerable resistance from the cold air which it must traverse, and which is denser and therefore firmer. In order to effect its ascent the warm air begins to work its way spirally, like a drill, or like smoke rising from the funnel of a steamer. Thus a hot day following a cool night produces a choppy sea of air.

The manner of this current which the airman encounters largely depends upon the physiognomy of the country over which he is flying. Over a forest or wooded country the flying is quiet and placid, because the leaves, saturated with moisture, are reservoirs of coolness and are warmed very slowly by the sun, and even when warm do not radiate much heat. A sandy beach, on the other hand, or a desert, is warmed very quickly, and in consequence the air above it rises in rapid spirals.

Sandy tracts separating wooded countries are always troublesome. The cool air of the woods pours down upon the hot air of the sandy tracts, the hot air in the meanwhile trying its best to escape to higher regions. The commotion may be imagined. The movement which the aeroplane undergoes over so diversified a surface may be compared to a continuous switchback. Powerless to resist these currents, all the aviator can do is to steer his craft, allowing the winds to carry him up or down.

The little islands of white cloud seen in blue and golden summer days are the lighthouses of the air. They signal danger to the airman. They are the tops of spirally ascending warm columns of air, and, just like a fountain, the cold air pours down on either side of the hot air.

If the airman has been drawn into such a fountain and escapes with his life, he can count his escape as marvellous. Almost invariably if he traverses such a geyser of air his machine turns turtle owing to the fact that the cold air pushes one side of his machine down, while the hot air pushes the other side up.

Bumps, however, are encountered only in the lower altitudes. Higher up they are replaced by clouds if anything more dangerous. In a cloud an aeroplane loses stability, which frequently ends with a nose-dive. These clouds vary at differing altitudes. Up to an altitude of 3500 feet the most prevalent clouds are Stratus, filmy and greyish white in colour. From 3000 to 6400 feet are Nimbus, or rain clouds. Cumulo-Nimbus, or storm clouds, are prevalent between an altitude of 4500 to 24,000 feet. From 10,000 to 23,000 feet are Cirro-Cumulus or "Mackerel Sky," and above 27,000 and up to 50,000 feet are Cirrus, or "Mare's Tail."

Above the clouds there is smoother sailing. Normal conditions prevail frequently. The warm air driving upward with uniform strength and wide layers makes an excellent medium for aircraft. If, however, there is a break in the clouds the airman must exercise the utmost prudence. Above such a break in the clouds there is no warm air to uphold the aeroplane. The air has been sucked away from this spot, and the rarefied air that remains cannot carry the machine.

Just as a skater drops through a hole in the ice, the pilot now drops through a hole in the air. The

sensation is sickening—the same sensation one experiences in the sudden downward passage of a lift. If the aeroplane strikes a warm current of air in its mad downward rush it is saved. The air checks the dropping of the machine.

Another interesting phenomenon above the clouds is the mirage that often obliterates all landmarks. In hot, tropical countries like Egypt it is particularly noticeable.

After noon, until towards sunset, for this reason, flying is useless. This condition embraces India, East Africa, Salonica, Palestine, and Mesopotamia. From the latter country a noteworthy instance is to hand. An R.F.C. pilot, reconnaissance bound, noticed a detachment of British and Turkish troops, as he thought, sitting watching one another, without an attempt to come to blows. He signalled to them desperately. And it was not until he found his signals entirely ignored that he realized that they likewise were unable to see one another. A no less unnerving adventure befell a pilot on the Western Front, returning from a patrol, one fine summer's morning, with low, racing clouds. He became aware of the presence of another machine that, in some mysterious fashion, always managed to keep ahead of him despite his accelerated pace. The chase continued for some twenty minutes. The other still retained his distance. He banked left. That tantalizing machine followed suit. He turned right: likewise the other. Until, with his hand already on his Lewis gun, he realized that it was the mirage of his own machine in the clouds.

There is the reverse side of the picture. The almost Arctic conditions that prevailed on the Western Front early this year. "Cold? There's nothing quite like it on earth," remarked one of our muffled heroes in answer to an enquiry. "How I'd

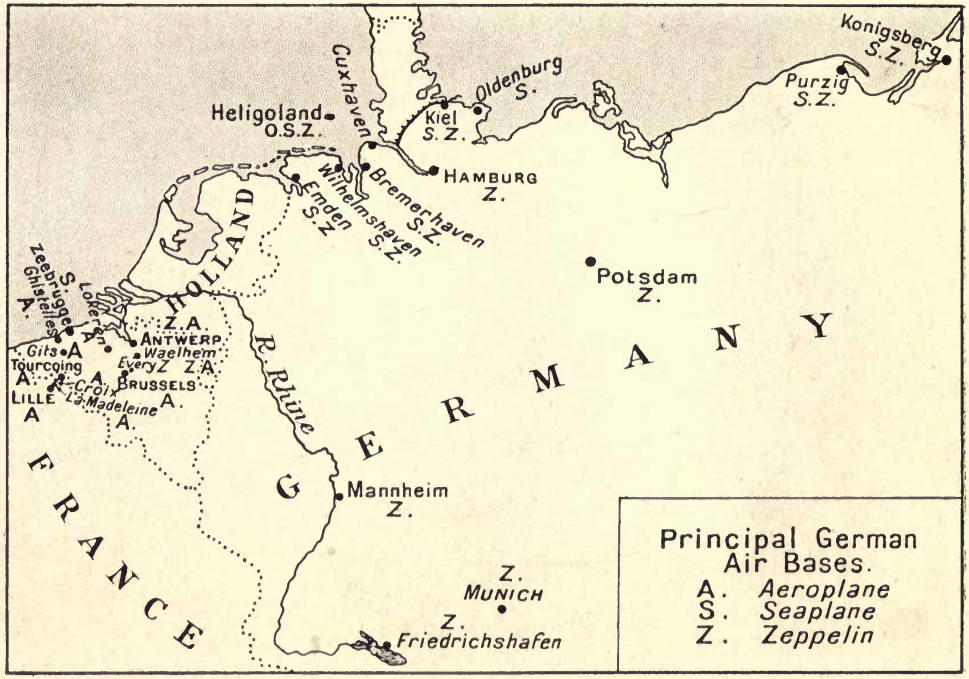
bless the man who invented a dug-out that could be carried in an aeroplane fuselage. Of course you may have the excitement of being shelled, and the possibility of having to dive into chilly space at a moment's notice, to keep you warm. But the atmosphere," he continued, "is about as frigid as any North Pole explorer could wish for."

It is interesting to pass over a high mountain peak in an aeroplane. The air swirls madly about the summit, seemingly attracting the craft like the magnetic mountain in the *Arabian Nights*. Disaster appears imminent, for surely the craft must be dashed to atoms against the walls of the peak. So thinks the inexperienced pilot. To his joy he finds that the aerial current keeps at a uniform distance from the surface of the mountain, rising as it rises, indenting as it indents, and in consequence he is carried in safety over the perilous height.

Having passed over the mountain top, he is confronted with the real danger. We all know how the water descends over the cliff at Niagara Falls. It describes a huge curve, beneath which it is possible to walk. The air swirls over the mountain in precisely the same way, the airfall also leaving a free space between the mountain and itself. The suction from this hole in the air is terrific, and the unwary aviator who happens into such an empty space is irrevocably lost.

High and low tides of the sea are of extreme importance to seaplane flying. A seaplane pilot setting out for some distant shore, upon arrival there might find the tide out and be unable to land, owing to the distance of the water's edge from the sheds.

The stars are of comparatively small value to the air pilot. Navigation thereby requires numerous heavy instruments, for which there is no space in the limited accommodation of an aeroplane.



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classes, and gave to each class a distinctive lettering. Thus P.L. was the Parseval Luftschift; L.Z. Luftschift Zeppelin.

To the Navy were apportioned two squadrons of four ships and a reserve apiece, and there was a common station possessed of four double revolving sheds. The life of each airship was assumed to be four years, and at the end of that period it was intended that new craft should be substituted.

August, 1914, found Germany possessed of 30 serviceable airships of all kinds.

The Navy estimates provided for 50 seaplanes. Six groups of 6 always to be in commission, the remaining 14 to be in reserve. At Cuxhaven a central station was erected; also six smaller stations, each with accommodation for 10 machines, personnel, fuel, and storage. Putzig, on the Baltic, was converted into a Naval Flying School, and other stations followed rapidly at Kiel, Sonderburg, and Heligoland.

Russia

The air history of our latest and greatest ally will, when it is written, serve to open the eyes of the British public to a more than considerable degree. Choc-a-bloc with interesting incidents, it will make obvious the fact that Russia had not only made great strides with her aircraft, but by August, 1914, was in the foremost rank of aeronautical Powers. Perseverance and practical application of science are the secrets of her success. Owing to State encouragement in the shape of big financial grants, when war broke out Russia had at her disposal about 300 highly trained military pilots, about 100 naval pilots, and more than 250 civilian pilots, while a large number of officers were in course of training at the various schools. Even the Germans were sur-

prised at the extent of her aerial resources, and Great Britain had no idea whatever of the progress made by her new Ally. In Russian aeronautical circles two names stand out above all others: they are Sikorsky, after whom the world-renowned giant aeroplane is named, and Chessborough, Mackenzie-Kennedy, a young Scotsman, who at the early age of twenty succeeded in attracting the attention of the officials, and by them was entrusted with important experimental work; and at twenty-eight years of age, a stranger in a strange land, became the presiding genius in aeronautical construction. The two men are the closest of friends, and their joint efforts have furnished over a score of different types of aircraft, from the giant "Sikorsky" to the baby scout.

Perhaps the greatest achievement in pre-war Russian aviation was the flight by Sikorsky, flying one of his own machines, 25th April, 1914. He carried 15 passengers to an altitude of 300 metres.

Here it will not be out of place to give a brief comparative table of the various belligerent Powers, the numbers of their aircraft, and of their trained military pilots in August, 1914.

COMPARATIVE TABLES

Country.	Aeroplanes.		Seaplanes.		Airships.	
	Craft.	Pilots.	Craft.	Pilots.	Craft.	Pilots.
Germany	850	1000	50	50	30	80
Great Britain	126	154	100	120	4	21
France	800	850	*—	—	28	30
Italy	210	200	*—	—	10	20
Russia	800	1000	†50	100	20	35

* Number unknown. † Rough estimation.

These tables naturally do not include either civilian craft or pilots.

France

France may well be called the birthplace of the modern aeroplane, for it was in that country that Orville and Wilbur Wright first carried out their experiments, that is to say experiments of an important nature. Previously, in America, they had made innumerable essays with simple gliding machines. At first the French Government were inclined to be sceptical, but after being convinced by numerous exhibitions in 1905, through the agency of a private company they purchased the invention for the sum of £40,000, on the condition that a flight should be made that showed a speed of 30 miles an hour. In this manner they gained a considerable advantage over the other Powers; together with an invaluable experience of motor racing, which sport served greatly to develop good engines, the most important asset to successful flying machines.

The first French officer took his certificate in 1909, and at the outbreak of the war there were 850 pilots and 800 machines, which were divided up into field squadrons each of 8 machines. The complete squadron was composed of 7 pilots, one of whom was in command, and 62 N.C.O.'s and men. These were again divided into three groups with headquarters at Versailles, Rheims, and Lyons. Towards the furtherance of this scheme £960,000 was voted in 1912, out of a total of £1,280,000 for military aeronautics.

Public subscriptions yielded a sum of £244,592. A proportionate part of this sum was handed over to the Government to buy 208 machines, but only 72

were purchased, and there was a considerable scandal created by the poor quality of these.

The Committee of this National Fund decided to devote £17,000 to the foundation of 75 scholarships for training the military pilots on the condition that the successful candidates signed an agreement to join the military flying corps when the course was completed. In conjunction with the War Office they selected 32 landing-places. A local committee of three military and three civilians planned the laying out of each new aerodrome. Twenty-five similar sites were under construction, the idea being to cover the entire area of the Northern and Eastern departments. All the aerodromes were joined up by telephone, and there were three alternative routes from Bordeaux to Biarritz, with an aggregate of 123 landing-places.

With seaplane craft the French had not made much headway. The Government at the Monaco meeting had purchased the two best machines for £2400 and £2000 respectively. In 1912 they voted £20,000 to this project from the Naval Estimates.

The airships were of the non-rigid type and small of bulk. There were 28 craft of varying sizes, with an average speed of 30 m.p.h. There were 15 airship stations dotted about the coast.

No experiments with anti-aircraft artillery are recorded, but the French pilots very wisely made preparation for future Zeppelin raids by continuous practice in night flying.

Italy

The war in Tripoli was of immense advantage to the Italians both in the matter of experience and development in aerial warfare. There, 4 officers in six months made an average of 78 flights apiece;

but on no single occasion was a passenger carried. Aerial photography was developed to an appreciable and considerable extent, which after proved of value. Two airships carried out 91 flights over the lines.

In Italy the monoplane was the favoured type of craft, and particularly those of Blériot, Nieuport and Bristol manufacture. There were 26 field squadrons in all, each of 7 monoplanes, and 4 squadrons of 7 biplanes, aggregating 210 machines. Each squadron was manned by 4 officer pilots and 4 officer observers and 24 men.

A somewhat curious and unusual difficulty arose in obtaining the necessary pilots, as the parents of the officers objected to their joining the flying services, as they considered such a course both degrading and derogatory. Nowadays they have become somewhat more enlightened.

A national subscription yielded the useful sum of £128,000, the major portion of which went to the purchase of the airship "Città di Milano," afterwards presented to the Army.

At the head of the military air service was a director, and under his direct supervision a battalion of specialists manning dirigibles at Lago di Bracciano, Venice, Verona, and Ferrara. Also two new forms of captive balloon were under their special charge. Again there was another air battalion, with centres at Turin, Somma, Lombardo, Aviano, and Pordenone, and the great aircraft factory in Rome.

The development of the Italian seaplane was very backward, although there were 15 stations along the coast. Airships were the most successful craft, some 10 in number with an average speed of 65 m.p.h. These were constructed in the aircraft factory in Rome, where 500 men were told off particularly for their construction.

Serbia

Even little Serbia, in the first of those mischievous and ill-omened Balkan wars, made use of aircraft. Her equipment certainly was not on a very large scale, consisting as it did of 10 machines, 8 of these, together with instructors, being supplied by the French, and 2 others seized on railway transit consigned to the enemy. The majority were shipped from France to Salonika, and there transported to Nish by rail. The latter town constituted the principal aircraft base, where numerous Serbian officers, for the most part cavalrymen, were initiated into the gentle arts of flying, observation and map-making. The difficulties to be overcome were innumerable, particularly those of adverse climatic conditions; and at times the cold was so intense as to bring the tyres rolling off the wheels, and to warp the woodwork of the struts and stays, and even the oil had to be melted in buckets before being fit for application. No mention of Serbian aircraft is made save at the siege of Scutari, but they have rendered excellent service. At least they gained valuable experience for the future uses of aircraft in war.

This, then, was the comparative position of the most important Powers of the belligerents in the opening stages of the 1914 campaign.

CHAPTER IV

WHAT FLYING IS

IT is not many years ago the brothers Wright essayed a first flight on a frail gliding machine along the sand dunes of the western coast of the U.S.A. and Count Zeppelin experimented over the waters of Lake Constance. Then a flight in the air was an event of world-wide importance. To-day it is a more than daily occurrence, and the number of machines and pilots in operation are beyond count. The war has done more to develop flying than would have been possible in twenty years under normal conditions. And it is to be regretted that this, the greatest and most far-reaching invention of all time, should have thrived the most under conditions that savoured largely of death and destruction. However, it's an ill wind that blows nobody any good.

To-day we hold the mastery of the air on all fronts. The enemy has been driven back helter-skelter to the safety of his own lines; to the protection of his anti-aircraft artillery. His policy of continuous offensive has been forcibly converted into one of defensive for all time. Yet Germany was better prepared for the war than we, and able to place in the field a numerical superiority in craft and trained pilots. But within six months of the outbreak of hostilities we had them well in hand; within nine, we had wrested from them their much-vaunted superiority.

How was this great feat accomplished? Regard-

ing the personnel at a modest estimate, one may say that only 10 per cent of our war pilots had previous experience of flying. For the rest they were drawn indiscriminately from every rank, class and profession. Brought together within three or four months, they formed the nucleus of an efficient fighting unit. The secret is, of course, national characteristics: the calm self-confidence and pronounced sense of superiority of the British egotist. The Air Service needed men, the applicants heeded not when or why or how. The youth left his counting-house, his office-stool, and his chambers; donned leather coat and skull cap, and lo, he was an airman. Better, he was endowed with individuality, a mind of his own, to reason and decide. A stripling youth, he was immediately given sole command on one of His Majesty's latest craft, with power deadly enough to wreck the half of a city; an area to navigate whose limitations knew only the land and the stars. The confidence was not misplaced.

The average Briton—hackneyed phrase—lacks imagination. Therein lies the first quality of the successful airman. To one with too great a sense of the imaginative flying offers cold horrors that would beggar Dante's "Inferno," or the efforts of the Spanish Inquisition. And last, but not least, he possesses the sporting instinct. The eye to time the ball, the wrist to play the straight bat, the head to take the steep hedge, will not fail him in the air. Flying is a sport! The only sport worthy of the name is flying! Sport quickens the mind, develops the muscles, supplies and develops self-control; each and every quality is necessary in flying.

Aviation is a youth-intoxicated profession. It is of the youth, for the youth and youthful in being, but wise in the inherent lore of the century-old

efforts of preceding generations. The successful effort has been built up mainly from the accumulated stores, of experience of the unsuccessful efforts of the past. Our fathers and our grandfathers each and every one were airmen at heart. The hunting squire and the wandering navigator looked up at the birds on the wing and envied. They had the quality within their breasts, but in its most primitive form, that waited only the freedom of inventive faculty to find voice. To the youth of each successive generation it was the same; it is a calling pertaining exclusively to the cool daring, the iron nerve and the reckless abandon of youth.

The latter is ever bold, yet with the quaint caution that lacks the decision of the older man; it requires that boldness to fling defiance from a frail aeroplane, strung up in the clouds, upon a great city hedged around with anti-aircraft artillery. He loves daring and adventure for the mere joy of it. He may glut himself with both in war-flying. Best of all, he possesses a nervous system unimpaired; to dive a cool hundred feet or so with a curse on his lips, but an unfluttered heart; to pass a shrapnel or H.E. burst at close range and never turn a hair; to sustain a mortal wound in mid-air and carry on.

Typical: there is one callow youngster of my acquaintance, quartered at an aerodrome somewhere on the Western Front. This hardened warrior of eighteen summers has downed more than his brace of enemy machines; made his aerodrome with struts shot away and petrol painfully low. He has nose-dived and spiralled and looped. Now he is pining his young life away with sheer ennui, because there is no new stunt left him to attempt!

There are those who would say he was suffering from air temperament. But does such a condition

exist? Opinion is greatly divided. On the one hand, it is said to cause a pilot to become reckless and light-headed; to suddenly discover all rules and regulations irksome. On the other hand, in the delightfully expressive phrasing of the Services, "It is all eye-wash." Such a condition does not and can never exist. Let us consider for a moment the man and his habits. Placed in a position of great responsibility, participating in a particularly self-centred profession that calls at once for prompt personal decision, foresight and judgment; he is no longer a unit, but a factor. To come to earth both literally and practically, to the status of a unit, in the space of time that his craft needs for descent were almost an impossibility. The individuality of the man is such that it cannot be checked and ordinated by commonplace regulations. But a far-seeing Service has already made allowances for it. He is granted privileges and liberties that the infantry and cavalry man would wonder at.

Perhaps a little of the glamour and the halo of mock heroism of the early days has by now worn off, but the airman yet remains the darling of the gods! We are apt to regard him, and especially on active service—a knight-errant of the twentieth century, *sans peur et sans reproche*, unmindful of the fact that flying is as much a prosaic business of the every day as is soldiering or seamanship.

Typical of this view, there arrived one day, unexpectedly, at a well-known naval aerodrome, a captain with a polite request for a flight. The pilot selected was a mere youth little past the blushing schoolboy stage. The senior officer, with a confidence peculiar to our island race, unhesitatingly placed full confidence in his youthful mentor, even to the matter of life and death. The day was ideal. The trip exhilarating. The passenger was

profuse in his thanks, terminating with a graceful luncheon invitation for the following day. The invitation was accepted, on the one part at least, with a grateful fluttering of the heart. They lunched *à deux* in a cabin hung about with many a quaint trophy, reminiscent of all quarters of the navigated globe, waited upon by a silent-footed, respectful marine. When the good things had been cleared away a box of Corona-Coronas was produced, and over their delightful fragrance they grew confidential. The captain, who wore on his breast a long string of decorations, honours of a grateful country, with an experience of men and matters that dated back many years, devoured the stories of this child of the skies, of another and unknown world, with all the eagerness, impetuosity of a midshipman. They were wonderful stories and matters of the air that were related. And the visit closed with a mutual promise of correspondence which has never lapsed.

From whence spring these youthful Valkyries of the air? The "shop" we know and are familiar with. Its value and efficiency were ably demonstrated in the hard-fought campaign of autumn, 1914. Osborne and Dartmouth are powerful names to conjure with upon the seas. But the airman! His Alma Mater is the British Empire; his university the wise counsellings of hoarse-voiced, capable warrant officers and non-coms., trained in the school of long experience. He is drawn from all ranks in life. A sprinkling of civilian aviators there were before the war, but they in numbers would furnish barely two squadrons; for the rest, they were barristers, clerks, public-school boys, engineers, undergraduates, journalists, motorists, and every other walk and profession in our national life. Unused to the air, within three or four months they

have been developed into efficient pilots. How has this great mystery been accomplished?

Let us consider, first, the requisites of the useful airman! First and foremost our national temperament and characteristics lend themselves easily to this new activity. To the youthful Briton, healthy-tasted, sport-loving, the air offers an irresistible appeal. It brings in its trail a pleasant savour of daring and adventure. The true airman must appreciate both these excellent qualities. Further, he must be possessed of good health. He must not suffer from heart trouble. The rise and descent through the various altitudes of the atmosphere, it has been proved by several very eminent physicians, greatly affect the heart. He must have good eyesight. This is imperative, for the major portion of his work, which will be of an observational nature, will take place at an altitude of 12,000 feet and over. For preference he should be between the ages of nineteen and twenty-four.

The good pilot is born so. He possesses an uncanny sixth sense of intuition. He is ready to the second for the unexpected nose-dive, tail-spin, or side-slip. He flies his craft, not as a machine, but as being one tangible body of which he himself forms part; knowing all its peculiarities — and there are many such faults and tricks; humouring it in its every mood, and, incidentally, flying by a sense of touch.

The aspirant to flying honours must be neither too tall nor too short. This is a matter to do with the steering of the machine. Be he the former, he will find himself cramped in the confined space between the pilot's seat and the rudder-bar. Be he the latter, he will find that his legs will not be long enough to reach that most important adjunct.

For preference he should be on the light side.

A TRAINING AEROPLANE IN MID-AIR

By permission of Whitehead Aircraft, Ltd., Richmond

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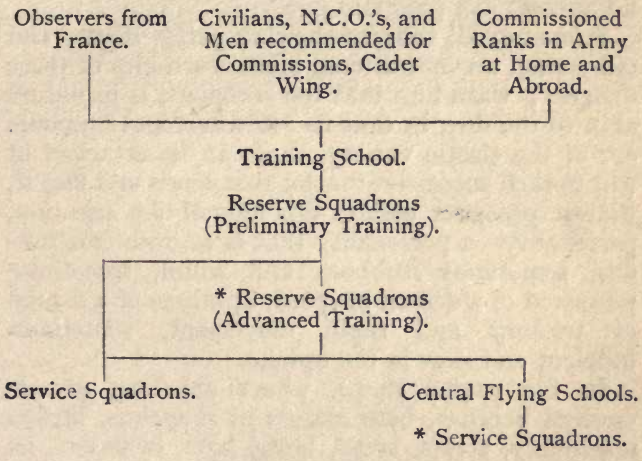
The aeroplane has only a limited lifting capacity. Therefore, taking into consideration that it is often required to take up two passengers, not to mention bombs, grenades, spare petrol, and a machine-gun, every extra pound of weight is of vital importance. His stomach must be strong. A good sailor usually makes a good pilot. If his stomach be weak he will be liable to air-sickness.

And the necessary pilots were supplied upon the principle of the organization depicted in the following diagram :—

THIS DIAGRAM WAS EMPLOYED BY BRIGADIER-GENERAL BRANCKER TO ILLUSTRATE A RECENT LECTURE OF HIS UPON THIS MATTER.



As to the training, the ethics of good airmanship are not to be found in any text-book. They develop under the hand, emanate to the mouth, and are passed on again from mouth to ear. The new hand is taught that his craft must be humoured, never

* Includes a course at the Aerial Gunnery School.

feared ; that the air is always planning and scheming to trap the unwary airman ; that gusts of wind will suddenly shriek up from the north or the east, the west or the south, and send him bowling over to destruction.

There are "bumps" that wait, gleefully invisible, his transit through the air, that rock and shake him, then send him upwards to the waiting clouds, that play with aircraft as a cat with a mouse, always ready to send the frail aeroplane diving to the earth. There are fogs that take the air pilot unawares and blot out sea and land, sky and heaven alike, and leave him nerve-racked in an impenetrable gloom ; sudden storms through which no aircraft can pass and live.

Solemn-eyed, tobacco-chewing petty officers and old-young, nerve-shattered pilots warn him of these dangers ; warn him that the aeroplane is in nature akin to the dog, in that its affections and humours are of the elastic variety, that can be attached at will to each successive master that tends and flies it, that it possesses besides this animal-like affection, personality—a personality that is at once treacherous, sometimes stubborn and wilful, sometimes possessed of a demon of speed, at others of a demon of trickery and rapid movement, sometimes indolent and slow in the uptake.

In the engine shops, where are long grease-covered benches, bare masses of shapeless, lifeless machinery, struts, stays, bolts, bars, cylinders, he will be taught to take down and build up engines of varying shapes and sizes ; to satiate their ceaseless appetite for reeking petrol ; to remove caps, clean plugs, and polish greasy cylinders. From the engine shops he will be taken to the open air, which he will much prefer, and be treated to several passenger trips up aloft ; allowed to fly the machine under

part control, and finally under his own. He learns to bank, first to the left, then to the right; to land, sometimes with, sometimes without, his engine.

There follows a short period of practice straights, up and down above the aerodrome. They start him off in the first place with taxi-ing, running the machine rapidly across the surface of the earth. From taxi-ing he is allowed to make climbs of thirty to fifty yards, leaping on and off the ground like a great kangaroo, then short flights to gauge height and distance, and by reason of alarming personal experiences he will learn that the movements of the controls when in mid-air must always be slow and deliberate; then the final trip alone, and the gaining of the much-coveted air certificate.

CHAPTER V

THE NEW DOMINION*

THE war has proved that aircraft has become an indispensable factor of a nation's safety, for the moment the war claims the world's output of its aircraft factories. In this country alone we are producing these machines in thousands, but even that huge outturn is insufficient to supply the demand.

The military side of the industry alone will always draw heavily upon the aircraft workshops, for we have it on no less an authority than the naval and military chiefs that when hostilities cease, then and then only shall we begin to build up our air services.

Large numbers of aeroplanes will be required to train our flying men, to equip squadrons in all parts of the world, and to defend our island home against the invader. The future that lies before the aircraft industry is obvious, judging it purely from a naval and military point of view, but the military demands will be as naught compared with the civil.

Mother Shipton is credited with having prophesied that "Carriages shall go without horses, and men shall fly." In this Mother Shipton has again been proved to be right. Carriages have long since gone without horses; men have now flown. Since the days of Mother Shipton millions upon millions of money have been invested in railways and "horseless carriages," fame and fortune having been won thereby.

* For matter contained in this chapter I am indebted to Mr. J. A. Whitehead, of Whitehead Aircraft, Ltd., Richmond.

Even railways have their limit ; they must confine themselves to their iron track, like the ships of the seas, which can only sail the ocean ; and " horseless carriages," which can traverse along our highways and byways but not beyond our coast-line. In the free element of the air we have none of these delimitations. Illimitable space provides us with a field of operation that knows no boundaries. Aircraft is becoming the greatest of all the industries that human ingenuity has devised for the benefit of mankind. It only remains for us to take advantage of the opportunity.

The uses for which aircraft are forthwith available are legion. Passenger and mail traffic have already become an accomplished fact. Italy to-day, to evade the submarine menace, sends her mails from the mainland to the island of Sardinia by air. Commercial transport in its many forms awaits only the opportunity for producing the aircraft facilities for bringing the industrial centres of the world into closer touch with one another, by the annihilation of time and distance which it will bring about.

These transformations are the inevitable result of the great strides that have been accomplished in the development of the industry. Aircraft has come into its own, and the future lies with the manufacturer and his supporters. They will " carry on " in the future even more effectively than they have done in the past. The world is ready and waiting for the new industry.

The far-seeing man who at this stage is ready to lend financial assistance to enable the manufacturer to develop the industry must of necessity reap a rich harvest.

While the present great struggle continues the Allied Governments take all the aircraft we can

produce. It is not only of the present, however, that we must think, but of the future.

It is only in the preparations now being made for the days of peace that England can hope to gain in aircraft construction that supremacy which she attained in the shipbuilding, textile and other trades. That vast field of enterprise which lies in the sporting, pleasure and commercial spheres of aviation only remains to be developed.

To comprehend adequately the remarkable strides made by aviation during the limited period within which it has become a practical craft, a recital of the principal incidents associated with it must prove interesting to all those who have watched its progress from its infancy and who are keen on its development.

Starting, then, with the year 1900, the Wright brothers built their first glider, and in 1903 made their first free flight with a motor-driven aeroplane.

In 1906 Santos Dumont won the first flight prize.

In 1908 Henri Farman won the Grand Prize with his Voisin biplane, and Wilbur Wright commenced flying in France.

In 1909 Cody began to make successful flights with the British Army biplane; while Blériot flew the Channel on Sunday, July 25th. In this year (August) the first Gordon-Bennett race took place at Rheims, and the first British Aviation Meeting at Blackpool (October).

In 1910 the London-Manchester flight was won by Paulhan.

In 1911 the circuit of Britain was won by Lieut. Conneau.

In 1912 the Royal Flying Corps was formed.

Towards the end of 1911 the first practical school of aeronautical engineering was established in this country.

Lieut. C. R. Samson, R.N., made the first flight from a British battleship early in 1912.

In January, 1912, M. Vedrines, on a monoplane, made a speed of 92 miles per hour; and M. Taboteau, also on a monoplane, covered 128 miles in 2 hours.

In 1909, at the first Gordon-Bennett Meeting, the Aviation Cup was won by Glenn-Curtiss (America) at an average speed of 47 miles per hour. In 1910 it was raced for at New York and was won by Grahame-White at a speed of 66½ miles per hour. In 1911 Weymann won it at Eastchurch, Isle of Sheppey, at 78 miles per hour; and in 1912 Vedrines won it at Chicago at 105 miles per hour.

At the latter end of 1912 Legagneux attained an altitude of 18,767 feet in 45 minutes—nearly 400 feet higher than Mont Blanc.

In April, 1913, Gustave Hamel flew, with a passenger, on a Blériot monoplane, over five countries —England, France, Belgium, Holland, and Germany —at a speed of a mile a minute, landing at Cologne, and this without making a single stop *en route*.

Previous to this, M. Pierre d'Aucourt flew from Paris to Berlin—roughly 680 miles—in 7 hours 32 minutes.

In October, 1913, the German aviator Victor Stoeffler, flew 1343 miles in 22 hours 47 minutes.

In the latter part of 1913, Chevillard toured over Denmark, Sweden, and Norway at a height of 6000 feet, to clear the mountains, and covered nearly 2000 miles in very mixed weather, thick fogs abounding.

At the same time, M. d'Aucourt essayed the Paris to Cairo flight, which he would have accomplished save for unexpected difficulties in Asia Minor.

In January, 1914, M. Pourpe flew from Cairo to Khartoum.

The aviator Garros, without a stop, traversed the

whole breadth of the Mediterranean, from France to Bizerta.

Jules Vedrines, starting from Nancy, covered the whole of Germany at a bound, and in eight successive flights reached Cairo by way of Constantinople, Asia Minor, and Palestine, thus emulating Brindejonc des Moulinais, who earlier covered a 3000 miles journey extending to Berlin, Petrograd, Stockholm, Copenhagen, and back to Paris.

A more remarkable performance was that of Helan, for this French pilot, flying an ordinary Standard monoplane, on 39 successive days covered a distance of 13,000 miles across country, through almost continuous wind and rain. Better testimony to the reliability of the aeroplane it would be difficult to find.

Had the war not occurred, May, 1915, would have seen a round-the-world race in 90 days, starting from San Francisco, for the Aero Club of America had sanctioned it.

Then with regard to large aeroplanes, M. Sikorsky's giant had, before the war, made a series of very successful flights with as many as 16 passengers.

Descending to statistics, the French Aero Club stated at its general meeting in 1914 that in the previous year no fewer than 8,150,000 miles were flown by French airmen, as compared with 1,875,000 miles in 1912. In other words, these Frenchmen alone flew in 1913 a distance equivalent to over 300 journeys round the circumference of the globe.

Enough has been said, however, to illustrate the immense importance of the aircraft industry, and although military and naval needs will ever be growing, commercial necessities will demand a very large output from our factories. The few facts here given amply demonstrate this assertion.

To those able to look into the future it is obvious that the demand for aircraft of all types will continue to increase, and that for a long time demand will be greater than the source of supply.

The genius which the pioneers have so strikingly shown in meeting each situation is ever ready to seize the opportunities presented. The exceedingly interesting history of the industry shows that the pioneers, instead of waiting for opportunities, have made them. Their imagination and foresight, coupled with great powers of organization and decision, have been the means of establishing on sure foundations the large businesses which, from the early days of the war, have rendered most valuable service to the country.

The experience gained in those early days, and continuously augmented throughout these testing times right up to the present, will be of inestimable value in entering, as soon as Peace is declared, upon the task of helping to equip the Empire in establishing commercial supremacy.

From that severest test of all, the test of war, the Whitehead-built machines have emerged with a solid reputation, and the great adaptability which the Whitehead organization has always shown will, when the new call comes, prove again its great worth. It is an invaluable asset.

It is very interesting to inspect a well-equipped aircraft factory and to watch the many varied operations in progressive stages until the raw material becomes the finished product and the machine is given its trial flight.

Go, for instance, to the Whitehead Works. Take a look at the mill where the specially selected timber is being prepared for the numerous operations through which it has to pass before finally forming part of the wonderful machine which glides

through the air like a gigantic bird. Note, in passing, the method by which the material which would otherwise be wasted is drawn by suction into the power-house, where it is used to produce gas, which in turn is utilized to generate electric current, which drives the machinery and lights the workshops.

In another department the metal parts are prepared. Here, while a large number of skilled men are also employed, women have taken up work to a degree not dreamt of a few years ago. In one section they sit in rows at the drilling machines or lathes, wearing blue overalls and caps ; in another, begoggled like motorists with leather aprons, welding metal parts together.

In the large building (which was opened by the then Lord Mayor of London in the presence of some of the most famous men in England and the Colonies) the chief parts of the machines are constructed and the machines themselves assembled. In one of the long galleries the women and girls, in their white overalls, cheerfully apply themselves to the woodwork, while in the other gallery are skilled workmen each concentrated on his particular job.

On the ground floor many employees skilled in various handicrafts are at work assembling the numerous parts which, fitting together with mathematical exactitude, compose the wonderful mechanical birds.

It is always a matter of great interest to the visitor to see the accomplished and highly finished workmanship contained in an aeroplane. Everything is of the best.

During the various stages of manufacture the different parts are tested in a most exacting manner, but it is at the aerodrome that, after careful inspection as a complete machine, the final test is made.

The pilot sits in the aeroplane, his sharp eyes

WOMEN WORKERS CONSTRUCTING AEROPLANE PARTS

By permission of Whitehead Aircraft, Ltd., Richmond

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noting everything, his ears listening intently to the stroke of the engine. At a given signal the blocks are withdrawn from the wheels. The aeroplane "taxies" along the ground, then rises into the air, climbing quickly and easily, as though delighted to demonstrate its power at last.

For a short while it appears to be travelling right away: presently it returns and, under skilful guidance, wheels and darts, climbs and dives, performing every evolution to the great satisfaction of the pilot, who, after light-heartedly "looping the loop," alights and confirms the impression already given to the spectators below.

Such then is a glance over the Whitehead Aircraft Works and Aerodrome, where, ever realizing that the best work as well as the best material must be put into aircraft, the founder, whose strong personality permeates the whole establishment, has always made the welfare of his employees a matter of first consideration, and has seen to the provision of modern workshops with up-to-date canteens in close proximity, and, in addition, has established the Whitecraft Club, which is an organization to bind together the best brain and hand workers for the common good.

Certainly, in peace as it has in war, Whitehead Aircraft is destined to play a great part in the development of the New Dominion.

The cult of flying has already passed into that of a profession, ranking with the best of the older industries. It has attracted the best of our Public School and University men, as well as those qualified by mechanical training to develop into capable engineers. It is a profession for the young, and should be adopted immediately a student has finished his academical career. It offers attractions not possessed by any other calling, and its emolu-

ments are substantial and increasing But the training must be of a whole-hearted character. It is not sufficient to have a knowledge of controls with deft hands to manipulate them, nor will dare-devil courage compensate for the lack of mechanical tuition. It is essential for the aviator of the future to possess an intimate knowledge of all the engineering details composing his machine, and practical ability to deal with all contingencies. This can only be acquired by a thorough course of instruction in all the data of aircraft. Consequently it is incumbent upon the incipient airman to learn his profession under the best of auspices, and to serve his pupilage in an establishment where, step by step, he will learn it thoroughly.

The School of Aviation established by Whitehead's introduces a distinctive method of tuition, inasmuch as a complete knowledge of the science is afforded, including the designing of an aeroplane, the building of it, and then the flying of the finished craft. This curriculum means that a pupil taking a course with this firm acquires all the technical knowledge necessary and then proceeds to the practical side, which includes a course of instruction on engine construction and running; in fact, if desired, the syllabus can be so arranged that when completed the pupil will be an expert.

The facilities at the disposal of anyone desirous of following this exceptional course of training are unequalled in the industry.

A pupil can go through the drawing office, and from there to detail construction, designing, and final erection. He will be instructed upon every item composing a machine. He can observe and take part in all the constructive details of an aircraft engine, and from thence pass on to the pilot in charge of flights, who will add to the knowledge thus

acquired by tutoring him how to control a machine in the air.

The works are unsurpassed in this country, and the aerodrome is second to none in the world; in fact, the pupil fortunate enough to pass through this school will acquire a knowledge of his profession that will carry him anywhere.

Every student attending the school will study under such idealistic conditions that success will entirely depend upon himself.

CHAPTER VI

FIRST FLIGHTS

THERE is recorded in some long-forgotten volume the case of the man who proudly asserted that he had experienced every danger that life is heir to, and truly enjoyed each one of them. He had crouched on the extreme crater of Etna when she had been in full eruption. He had escaped with his life from a land-rending earthquake. He had swum in the raging seas for half a day after a shipwreck. He had cheated death in the forefront of a bloody battle. To him danger was danger no longer. It was an event, a dramatic incident in his life in which he played conspicuously before the blinding limelight of publicity. To the small boy just breeched there comes a similar emotion. He feels the eye of the whole world to be upon him. The gawky schoolgirl with the flapping pigtail lately bound round neatly in a bulging bun ; the youth at school enjoying a first surreptitious cigarette in some deserted corner of the quadrangle ; the airman making his first flight aloft, share equally this feeling.

There is a call in the air that stirs strangely, irresistibly, some hitherto hidden chord in his heart. He is literally longing to try his wings. To see, to learn, to hear, to know, all are insufficient. He wants to do. For in the doing lies realization ; the air is before him, wide, clear, seductive. That vampire voice whispers in his ear. He falls whole-heartedly

to such seduction. He does not yet know; that gentle tone is ever waiting to send the blood pulsing through his veins, the riot of madness to his head; his craft and his unwary self to destruction. He does not know, because he has not learnt. That alone is possible in the hard school of experience. But, gently! Caution and prudence are pearls of price to the pilot of the air.

The eventful day at length arrives. He waits impatiently, strangely uncomfortable in his unusual clothing—loose-fitting leather coat and trousers, skull-cap and goggles. He clambers aboard the observer's seat. At last his dreams are to be realized.

It is the great test, that first venture. Either the pupil will take to the air immediately, and after the first preliminary nervousness be quite at his ease, or, *per contra*, he will never make an airman. Hardly a matter of personal courage this; more of temperament. I knew a man in the Air Service—a quiet, unassuming sort of fellow; an observer by circumstance. He should, by rights, have been directing an army corps. It was his custom during spare moments in the air to chew milk chocolate and munch apples. A pilot glancing round at a strenuous moment would find his observer's head buried over an orange. And once, under a particularly violent bombardment, he had sat at the back and calmly taken photos of the bursting shrapnel. At the other end of the scale we have the case of a major of artillery—a man who had fought all through the South African War, and had won a D.S.O. for gallantry in the field. "He had never been up before," he said, "and was anxious to experience the new sensation." Permission was granted. Away he went with an experienced pilot; true, he was known as a daring "stunter." But when they landed his passenger sat like a statue for fully ten

[illegible]

mental ability. Which, after all, is nothing more than mere snobbishness.

But to repeat: the new hand has taken his first timorous glance over the side, when the machine lurches in an alarming manner. He finds himself staring up at the sky. For the first time he feels really frightened. However, the machine is not, as he believes, attempting to hurl itself to the ground below, but performing the very usual manœuvre of banking—turning—though somewhat sharply, in a left-hand direction. He is not reassured until he catches sight of the pilot's face behind him, and then he knows that the angle has been greater than usual for his own particular benefit—to try his nerve.

Apropos to this matter of manœuvring in mid-air, each movement must be as gentle as possible. A rapid jerk at a critical moment may upset the machine entirely, bringing it into that unpleasant position known as a nose-dive, from which an aeroplane can rarely recover. Also are there "tail-spins," "over-banks," "slippings-out," "pan-cakes," and "stalls." The due avoidance of these ills is all part of this novel curriculum.

However, the worst fright of all is yet to come. The engine suddenly stops. The customary rhythmic roar fades away into coughs and splutters. No longer does he find himself staring vaguely up into the heavens, but cheek by jowl with the earth, that seems, more every second, rushing up to meet him. He is surprised—more, alarmed—at the speed at which the landing is accomplished. He expects a horrifying jolt as the machine first touches the earth, and is pleasantly surprised to find how gracefully the landing has been effected. The machine is driven across to the hangars, where the engine is shut off, and that wonderful craft of might

becomes again an inanimate block of metal and wood.

The next few days are busy enough. Wireless, map-reading, gunnery, and then he is sat in a machine in a hangar and put through the various movements. His feet are moved left and right, making an imaginary turn in the clouds. With a reverential touch he pulls back the "joy-stick" to make her rise, and pushes it forward to descend. With other quirks he makes hazardous attempts at distinguishing strange craft in mid-air. It is an amusing pastime, for this art demands months of experience to acquire.

Passenger flights with an instructor follow, perhaps six or maybe ten in number. Until, one fine morning, he is ordered to attempt a solo trip, with a postcripted hint to be careful with his landing.

If only those other grinning idiots would go and bury themselves for the time being, he would feel much happier. Something's bound to happen with that gang jeering and ragging alongside, as he takes his seat, Afraid? Not likely. But, dash it all, what the devil do his aviationable hands mean by trembling in that absurd manner? Was that his voice, that feeble order to the mechanics to let go? If it was—— Possibly he got off in an orthodox manner, but hardly liable to appeal to the warped understandings of fault-detecting instructors. Well, never mind. All aboard. Drat the machine!

So it goes on. The aeroplane behaves in a really disgusting manner, don't you know. He makes his landing, never more thankful in his life. Was it a good landing? Why can't that fool instructor say something, instead of——Oh! So it was. Discretion is more congenial than valour.

Fast and slow machines; there is as much difference between a Morane and a B.E.2.C. as between a

40 h.p. and a Ford. From "crocks" he graduates to "buses," "buses" to "scouts," and so on.

He has the undisputed right to negative any machine or weather. But that is not the way of the Quirk. He is an airman of twelve hours' fame, with a strip of pasteboard in his pocket, bearing the magic sesame of the Royal Aero Club. The fall follows pride like a dog after a new bone.

Quite 70 per cent of air smashes happen to Quirks and Huns. One youngster, up for his solo trip, was troubled with engine failure at 5000 feet. He pulled her out of the resulting dive, only to lose his engine again when 400 feet above the ground. By—unconsciously—superb airmanship he got her into the landing ground. But here disaster awaited him in a sudden gust of wind that caught the tail of the aeroplane and, bowling her over sideways, crashed her twenty feet to the ground. Dragged from the midst of the debris, he was a sorry spectacle, with two fractured ribs and broken collar bone. Five months later, to the surprise of all concerned, he was flying better than ever.

Giving a display of excruciating banks and daring downward sweeps over the pier of a once thronged seaside resort on the east coast, a seaplane was seen to crash down on to the shore. It happened so suddenly. One moment the craft had been flying majestically overhead, the next it was a mass of shapeless fabric lying in the edge of the sea. Mechanics hurried to the spot, prepared to find the badly mutilated body of the dead pilot. Instead, there rose slowly from the midst of the wreckage a sorrowful figure, immersed to his shoulders, spluttering salt water, and giving vent to his feelings in true nautical style.

Like the liqueur to a good dinner, as satisfying, as appropriate, the taking of the certificate con-

under the preliminary training of the pilot in the air.

There are several tests, the official rules for which are as follows :—

A and B.—Two distance flights, consisting of at least 5 kilometres (3 miles 1[illegible] yards), each in a closed circuit, without touching the ground or water; the distance to be measured as described below.

C.—One altitude flight, during which a height of at least 100 metres (328 feet) above the point of departure must be attained; the distance to be made from that height with the motor cut off. The landing must be made in view of the departure with the motor [illegible]

must know more than a little concerning artillery, both light and heavy. As a man he is abused more than he is valued. He takes the same risks as the pilot; yet when any brilliant feat is accomplished he is ignored the while the pilot gets all the kudos. The nerve strain for him is greater than it is for the latter. He places his life, unreservedly, in the hands of another man in that most perilous of enterprises. The strain on his nerves may be judged from the fact that many of our best pilots have openly stated that they would not be observers for all the wealth in the world; that they would not have the nerve!

The art of observation is considerably greater than that of pilotage. The latter is purely mechanical, the outcome of practical experience. The pilot is part of the craft, in like manner to a chauffeur hired with a car from a garage. The observer supplies the brains, the head, and the eye. He is virtually in command. The pilot must obey his orders as to course and altitude, but neither is dispensable to the other.

There is a sharp dividing line between the two classes of work. Aerial strategy is concerned for the most part with long distance raids into the enemy's country. On these occasions the pilots invariably fly alone. There is only a limited space in an aeroplane, and with a plentiful supply of bombs and spare ammunition aboard, without which the object could never be attained, there is no room for an observer. Other objects are the destruction of lines of communication, railway junctions, high roads, headquarters, ammunition parks, etc., or the bombardment of fortified towns and areas within the enemy's country. Aerial combat might also be included in this category. And almost all aircraft work at sea is strategical, as witness the various raids on Cux-

haven and similar ports, which were in nature akin to naval bombardments. The strategical moves, on the other hand, are more local in nature and confined within the limits of the fighting lines and the artillery range. They cover a very wide area. And with them all the observer is practically concerned.

Also the observer must always try to keep in touch with the military situation, and particularly in the encounter battle be aware of the dispositions of our own troops and the positions of our artillery. Again, there are two distinct classes of reconnaissance—" Line " when observation has to be made along a line between two given points on the map, these points having been marked in previous to leaving the ground, and " Area " when the observation is over an entire area or district—which occupy the best part of the observer's time, and reconnaissance again is a very comprehensive issue. It is so delightfully indefinite, embracing anything from the movement of an army corps to the detection of a trench mortar. No circumstance, however small, but is worthy of note. And when there is no movement, nothing to report, that is the most consequential matter to report of all. It might signify the abandonment of an important position, or, on the other hand, might be merely a " blind " on the part of the enemy.

Decoys and " blinds " must also be allowed for, as the hiding of a gun emplacement, captive balloon, or ammunition park by foliage and branches of trees. Unless closely watched these matters may cause considerable error and misunderstanding. So much depends upon the vision, accuracy, decision, and certainty of the observer.

A railway train under observation becomes a factor of the war. Direction, component parts,

freight—when possible—length, position, time, all mean so much to the man who is planning and plotting over his map miles behind the lines. There are trains in the sidings, some goods, some passengers; locomotives waiting with steam up; or the lines are entirely devoid of traffic. There is the sea, with the numerous ships passing to and fro. There, again, their nature is to be considered, direction and position; whether cargo boat, oil ship, steamer, or vessel of war. The condition of the coast-line. The ships lying in harbour; the high-roads leading up to the lines; whether they are congested with troops or the reverse. The position of fresh gun emplacements and headquarters to be noticed. And all these matters have to be entered upon an official observer's sheet; as baffling to the uninitiated as a Greek play.

However, besides discussing the various arts of observation, we must consider the general position. As has already been stated, the advent of aircraft rendered a sudden or surprise movement impossible. The aeroplane hovering over the enemy's lines is cognizant with every movement that takes place therein. Therefore it behoves the military commander not only to keep his own aircraft constantly scouting over his opponent's positions, but also to keep him from retaliating. It is most necessary to hold and to keep the mastery of the air in the section that he commands; and the only successful policy is that of a constant offensive. This in fact has been the policy of our military commanders throughout the whole of the present campaign. Whereas the enemy has acted, almost invariably, on the defensive. This accounts to a great extent for the higher proportion of the loss of craft on our side as compared with the enemy.

As the war progressed the difficulties of obser-

vational work increased. The anti-aircraft gunners became more accurate in their firing, and drove the aircraft up to a higher altitude. This increased the difficulty of clear vision, and the observer was forced in many cases to make use of field-glasses to scan the various necessary objects on the earth. This, with the constant vibration of the machine, was no easy matter. And even at the increased altitude craft were apt to return to their bases, riddled with shot and shell holes. In one particular instance an R.F.C. machine returned from a reconnaissance trip with as many as 365 various holes in the wings and fuselage. Of course, the obvious remedy would appear to be to armour the craft throughout. But here again the difficulty of "lift" manifests itself. The framework of the craft must be constructed as light as possible. Armouring, then, is impossible.

Bomb-dropping is another matter that comes within the scope of the observer, also the direction of artillery fire, and last, but not least, photography.

The main characteristic of aerial photography is the danger involved in getting down to the necessary altitude to obtain the required focus. This altitude varies from 3000 to 5000 feet with the old-fashioned cameras, from seven to ten with the later instruments. It is never a very pleasant business, and particularly unpleasant if the anti-aircraft gunners in the district are accurate in their marksmanship. And weather conditions play no small part in obtaining the necessary results. The day must be sunny, clear, and cloudless.

Particularly must there be no clouds. A photo taken from, let us say, 7200 feet might be blurred and useless, whereas another taken at 7000 would come out distinct and clearly marked. Between

7000 and 7200 feet probably there lay a thin film of mist or cloud. These different strata of atmosphere —for the air is not one huge void, but is made up of varying layers of air and mist and cloud—have always formed one of the main deterrents to obtaining clear negatives with a camera from above.

For aerial photography is by no means a new art. As long since as 1858, Nadar, a Frenchman, made experiments with an ingenious contraption that consisted of a captive spherical balloon, in which there was fixed a small round orange-coloured tent, lined with black. The tent was to be used as a dark room, and in it he proposed to develop the photographs that were to be taken after the balloon had been let up.

From an altitude of about 1500 feet he obtained some excellent results. Then a leakage of coal gas from the neck of the balloon above the car spoilt the plates. Three years later King and Black, two enterprising New York photographers, flying a free balloon over Boston on a clear day at an altitude of some 800 feet, obtained some excellent panoramic views of that city.

About this time Negretti returned from Italy, where he had been engaged in extensive experiments, to London, and in similar fashion succeeded in obtaining negatives of almost every district and landmark in the vicinity of the metropolis.

The next mention of camera work from above was during the American Civil War, when it proved extremely useful to the Northern States armies for scouting purposes. An amateur aeronaut named Lowe placed his services unreservedly in the hands of General McLellan. The balloon was captive, and at 1000 feet he obtained clear results as far as Manchester on the extreme west, and the Chika-

hominy on the east. After his exposures had been developed the disposition of the enemy cavalry, infantry, and artillery positions stood out in bold relief; likewise trenches and earthmarks.

Lowe invented the principle of map-reading which is used by all observers of the present day, namely, that of dividing the face of the map into a definite number of spaces by means of transverse lines at regular distances. These spaces are then lettered, so the district in the top left-hand corner would be A, that in the top right-hand corner B, in the bottom left-hand corner C, and so forth. The spaces made by the lines were numbered 1, 2, 3, etc. Thus a reading would be given, instead of "Enemy's heavy artillery immediately in rear of Richmond," "Enemy's artillery position A1D67."

However, even with the best maps which could be supplied the results were not as satisfactory as those obtained by the use of the developed negatives. The perspective of the former with regard to the latter was incomparably worse; differences in altitude could not be distinguished with such accuracy, and rivers, woods, buildings, churches, etc., were less easy to define. Therefore it was determined to combine and to use map and photograph together. The district on the map was covered by the lens of the camera, and the developed negative was compared with the map.

Many plans have been formulated to do away with the human aerial observer, the most notable of them a complicated idea, in which there figured a camera with a rotating prism. The prism supported the plates and was rotated by means of an electric current controlled by a switch on the ground below. However, it proved impossible to photograph any particular spot, added to which something was always going wrong with some part of the delicate

machinery. This idea was abandoned for another and even more complicated scheme that required seven cameras. These seven cameras were placed in a large wicker-work basket in such positions that six of them pointed through specially made openings in the sides, and one pointed downwards through the floor. Thus a complete panorama was obtained. This plan was afterwards adopted by the British, French, and German military authorities alike. Later, in the earlier part of the twentieth century, an Italian inventor constructed a camera specially for air reconnaissance work. This was a permanent fixture beneath the under carriage of the machine. It was so designed as to hold 300 negatives, which were released automatically at given periods. A series of views was therefore obtained at regular intervals, giving an absolutely consecutive and complete record of the course of the ground covered in the trip. The pilot regulated the time between each photograph automatically with the altitude of the aeroplane. The higher the altitude the fewer are the exposures required. From a height of 3000 feet it is estimated that 300 such views would photograph completely an area of the surface of the earth of at least 160 miles long and one mile broad.

With regard to the free balloon and airship, with the former when well under way the passage is smooth, notwithstanding a slight rotary movement, which is replaced by a slight throbbing caused by the engine or engines, for which allowance must be made.

Light and atmosphere, though of great importance for successful photography on the earth, do not there play the important part which they do in aerial work. For instance, the usual negative is obtained by allowing the sun's rays to be reflected off the object to be photographed on to the camera lens, and these

rays from the sun have to pass through a fairly dense atmosphere before reaching the object; and in the case of aircraft they have to be again reflected through the dense atmosphere, made up of particles which not only reflect but absorb light, back to the shutter of the camera.

It was thought at first to be impossible to operate a camera in an aeroplane or a seaplane owing to the excessive vibration caused by the engine; but this theory proved wrong, for, given a reliable instantaneous shutter, a clear day and agreeable atmospherical conditions, really excellent results can be obtained.

Modern conditions have modernized methods. To-day a large camera, remarkable for strength and clearness of its perspective and improvements of all kinds (though what these improvements are one is not permitted to state), is fitted in the base of the fuselage so that the lens will be pointing at right angles with the earth. This is a most important detail, for should the camera be at the slightest angle past 90 deg. the picture will be out of focus in certain parts.

Perhaps the most useful purpose to which the aerial photograph is put is a comparison, day by day, of negatives of certain sectors of the line. Here a new trench will be discovered one day; there a new gun emplacement another. Thus a constant and careful watch can be kept on the enemy's present and intended movements.

Anent this matter, Mr. H. G. Wells, the greatest authority of the war, wrote recently, in an article in the *Daily Chronicle*: "An air photograph to an inexperienced eye is not a very illuminating thing; one makes out roads, blurs of wood and rather vague buildings. But the examiner has an eye that has been in training; he is a picked man; he has at hand

yesterday's photographs, marked maps, and all sorts of aids and records. If he is a Frenchman he is only too happy to explain his ideas and methods. Here, he will point out, is a little difference between the German trench beyond the wood since yesterday. For a number of reasons he thinks it will be a new machine-gun emplacement; here at the corner of the farm wall they have been making another. This battery here—isn't it plain? Well, it's a dummy. The grass in front of it hasn't scorched, and there's been no serious wear on the road here for a week. Presently the Germans will send one or two wagons up and down that road and instruct them to make figures of eight to imitate scorching on the grass in front of the gun. We know all about that. The real wear on the road, compare this and this and this, ends here at this spot. It turns off into the wood. There's a sort of track in the trees. Now look where the trees are just a little displaced! (This lens is rather better for that.) That's one gun. You see? Here, I will show you another.

"That process goes on two or three miles behind the front line. Very clean young men in white overalls do it as if it were a labour of love. And the Germans in the trenches, the German gunners, *know it is going on.* They know that in the quickest possible way these observations of the aeroplane that was over them just now will go to the gunners. The careful gunner, firing by the map and correcting by aeroplane, kite balloon, or direct observation, will be getting on to the located guns in another couple of hours. Every day the French print special maps showing the guns, sham guns, trenches, everything of significance behind the German lines, showing everything that has happened in the last four-and-twenty hours. It is pitiless. And, as I

say, the German army knows of this, and knows that it cannot prevent it, because of its aerial weakness. That knowledge is not least among the forces that are crumpling up the German resistance upon the Somme."

Shells. Red and white, black and grey, snap, bark, youf against the clear sky light. Above, the frail speck of an aeroplane—but there, aeroplanes don't hover. More shells, more flame patches. A slight movement—down or up ? Neither. A little forward. A mighty sweep. Then, back she goes into her original position. Below, field-glasses are snapped to angry eyes, gunners work at the gun on the grey-green motor trolly vehemently. Range 8000 feet. Try 8500. More craning of necks. Loud detonations at hand. Indescribable passages, up and up, up and up into the air—more black and grey patches.

"Thank heaven those damned Huns can't shoot straight," murmurs the pilot. The observer busies himself over his photographic instruments, conjuring up from the depths of his boots resonant curses upon the fool inventor of aerial photography. Lower, he beckons. With a sorry grimace the pilot obeys.

Angry the gunners, louder the guns. Lower! Lower! Ah, splendid! Drat the Archies! Home, Jeames! Like a meteor across the sky the plane turns and dashes for home.

Late afternoon. Early 1916. Battered, weary, glorious lines of British infantry falling back upon shell-shattered Ypres. At their last gasp there comes a Heaven-sent breather from the tornado of bursting shells and hordes of Hun soldiery. Battalions begin to sort themselves out from the mêlée. The remainder seize the opportunity for a well-merited doze. To them come that glorious after-glow of

victory, splendidly won. When the bombshell bursts.

A morning's aerial photograph, hastily developed, discloses as far as eye can reach, mile upon mile, road by road, field by field, dim, indistinct figures: advancing infantry and cavalry! Never was such a warlike concourse viewed.

"Supports? My personal staff and myself," says the C.-in C., "carry on." And carry on they did to some purpose, saved, at the last moment, by an aerial observer's photo. Later in the war, an Admiralty official, after a series of raids on Zeebrugge, Bruges, and Blankenburghe, informed us that aerial photographic reconnaissance disclosed serious damage to naval and military works.

Among other things, photographic experiments during the war have served to show that if the surface of the earth has been recently disturbed in any way—as a newly constructed trench or gun emplacement, or a footpath across a field—it shows up most distinctly on the camera negative. Such photographs of the "lines" from one end to the other are in the possession of both our own and the enemy commanders alike.

The cinematograph instrument has not been made use of to any great extent; but the few results obtained are highly satisfactory, and point to its continual employment in the near future.

Another ingenious device is the camera obscura. This is practically a large camera built upon the ground with its lens pointing upwards. Inside is a table on which a white sheet of paper is stretched at a convenient height for the observers inside to look at and mark with a pencil. An aeroplane flying approximately over this camera obscura would naturally throw an image on the paper, and the observers, by following the course of the aeroplane

with a pencil, can tell exactly how far from being directly over the camera obscura the pilot is, and approximately how fast he is going. Both methods are employed in the training of future pilots.

CHAPTER VIII

TACTICS AND STRATEGY

TO predict upon an uncertainty has always been a dangerous pastime. To predict upon such uncertainty biassed by a rather too great element of the unexpected renders the pastime doubly dangerous. Thus it is with the air. But at least of one thing we can be certain. Aviation is practically akin to sea navigation. The movements of a squadron of aeroplanes in mid-air differ very slightly from those of a squadron of light cruisers at sea. Particularly is this fact noticeable with the airship. The formation of a squadron of Zeppelins going into action is "line." One following the other in ordered and monotonous regularity. A squadron of big ships putting out to sea is surrounded and protected by a host of smaller fry, as torpedo boats. A bomb-raiding expedition in the air is convoyed by smaller and fleeter battleplanes. Will naval policy then be applied to the future strategy and tactics of the air ?

Thus far the majority of actual battles up above have been waged between single craft of either side. This condition is greatly to do with the policy adopted by the enemy ; which is invariably to remain on the defensive, and seldom to give fight without the radius of their own lines. But the day is not far distant when aerial battles will take place on a greatly extended scale. When squadron will

meet squadron, or flight will meet flight, and the fight will continue until either their ammunition has given out, or a sufficient number of machines have been " downed " on either side to necessitate a retreat. Thus far, then, we may say that aircraft have been merely an adjunct to the military offensive. In the future they will be a factor, and a dominating factor at that. This view-point, of course, with the exception of the Zeppelin raids, and they may be considered more in the light of privateers, with a roving commission to destroy and damage at will. Which brings us to the matter of the various craft.

In all there are three distinct types of aircraft, and of these various types the aeroplane has, thus far, best proved its worth, and therefore it is permissible for us to conclude that the aeroplane has the most promising future.

And the future of the aeroplane depends to a great extent upon the matter of " lift," that depends to a great extent on engine-power. And both craft and engine depend upon the effort of the designer and the construction. The future lies in their hands. The more prolific, the more inventive they become, the more the aeroplane and similar craft will develop.

Theirs is a responsible and enviable task. There are as many different types of aeroplanes as there are ships at sea. Each particular grade of work requires a particular style of craft. A battleplane, for example, must be a craft that is both fast-flying and quick-climbing. That is a matter to do with the ethics of aerial combat. Reconnaissance craft must have ample powers of duration. And a bomb-raiding machine requires every available pound of lift for spare petrol and bombs, and must be as lightly furnished as possible,

Another factor that must be taken into consideration regarding war aviation of the future is the anti-aircraft gun. The firing has increased quite 80 per cent in accuracy since the opening stages of the war. This is due to constant practice, now covering two and a half years. And the more accurate the anti-aircraft firing the greater must be the altitude of the raiding craft. This again will require a further development in engine power.

So far we have considered the subject solely from the view-point of trench warfare; when the great push comes and the opposing armies are constantly on the move, what will be the value of aircraft then? Will the work of the airman be rendered useless, or will it become the deciding factor? The majority of experts incline to the latter view. We have only one precedent for comparison.

When the German hordes were overrunning Belgium in the autumn of 1914, what saved our tiny army from annihilation? Principally the dogged tenacity of the British Tommy and the untiring efforts of our, then, mere handful of airmen. The advent of aircraft enabled us to turn an ignominious defeat into a glorious victory. When once we get them on the move again, aircraft will prove their value as never before have they proved it. Then it will be necessary for us to adopt a yet more stringent policy of offence to prevent the enemy divining our new movements, and this policy will ensure tremendously heavy casualties.

Perhaps Germany has realized this fact, and has already made the necessary preparations. Be that as it may, we receive constant reports from neutral visitors of the fact that the enemy is evincing signs of considerable activity in the matter of construction. To-day almost every factory and munition works in Germany is working under high

pressure, turning out new aeroplanes and Zeppelins. The moral is obvious!

Turning our attention to other craft, the seaplane, we may say, is still in the most elementary stage. Its upholders, however, vouch for it a great and useful future. And as far as this country is concerned, by reason of our geographical position, it behoves us to further the development of the seaplane to the uttermost limits of our power.

For the rest there remains but the Zeppelin for consideration. Allowing for the fortunate results of the last two raids, the Zeppelin as an offensive unit of the air is *non est.* For the present.

It is not to-day that we need fear these cumbersome craft, but in the future. Germany, beaten on land and on sea, will yet cling to her long-cherished dreams of world domination. To this end she is already preparing a large and powerful fleet of the air. Without a declaration, she could send out under cover of darkness a powerful fleet of Zeppelins, plentifully supplied with bombs, that would be hovering over London before we were even aware of her intentions. Another matter to be taken into consideration is the possible silencing of the engine —which experts consider quite feasible—and the development of the aerial torpedo, navigable from a distance of as much as five miles, and containing an amount of explosive proportionate to a dozen bombs.

Per contra the Zeppelin is of inestimable value as a naval scout. On no less than three occasions it has been instrumental in saving the enemy High Seas Fleet from annihilation.

On December 16th, 1914, occurred the German naval raid on Scarborough and Whitby. We had enticed the enemy to the open sea and into a trap. By all the rules of warfare their ships were already

as good as sunk. Then, as our ships were closing into range, down came the fog. Their Zeppelins hung above and directed the course of the fleet by wireless, convoying them into harbour again without the loss of a single vessel.

On the occasion of the battle of Jutland Bank our Fleets lay across the North Sea like a great net waiting for the enemy to return. They did not reach harbour again without a serious engagement. But their Zeppelins undoubtedly saved them from further disaster by keeping constantly in touch with the movements of our Fleet.

Again, the audacity of Scheer in making use of the German High Seas Fleet in the raid off Flamborough Head, August 19th, 1916, was warranted by a carefully organized vanguard of Zeppelins which kept constant watch upon the only routes open to Jellicoe and Beatty, and immediately they were sighted gave warning by wireless, and the enemy retired at full speed. Again without loss.

CHAPTER IX

BOMB RAIDS

VAGUE indeed are the opinions held by the general public as regards aerial bombardment. The very novelty of the affair subscribes to its barbarousness. Zeppelin and aeroplane raids on this country are considered the last word in Teuton Kultur. Yet, looking at the matter from an unbiassed point of view, such raids are perfectly legitimate!

To repeat: aircraft have revolutionized the theories of warfare for all time. Formerly the battle area was confined to the theatre of operations, and the range of artillery fire. Now it has generalized. The entire air-shore within the radius of the long-distance aeroplanes is the battle area. A firing-line is non-existent. The war is carried to the uttermost boundaries of the countries engaged, either by Zeppelin or super-aeroplane.

Of the two craft the former may be said to be the ideal night-raider. It has a decided advantage in the matter of bomb-space aboard. Considerably heavier bombs can be carried. It is also able to hover over its objective. The best type of aeroplane for this class of work is one with good powers of duration and a reliable engine. And usually a one-manned craft to allow sufficient space for spare bombs.

The guns form the most formidable deterrent to successful air-raiding. With regard to the enemy,

the majority of his A.A. guns are mobile—that is to say, they are mounted on either motor-lorries or railway-trucks and can be moved quickly and easily from place to place. Another method is to

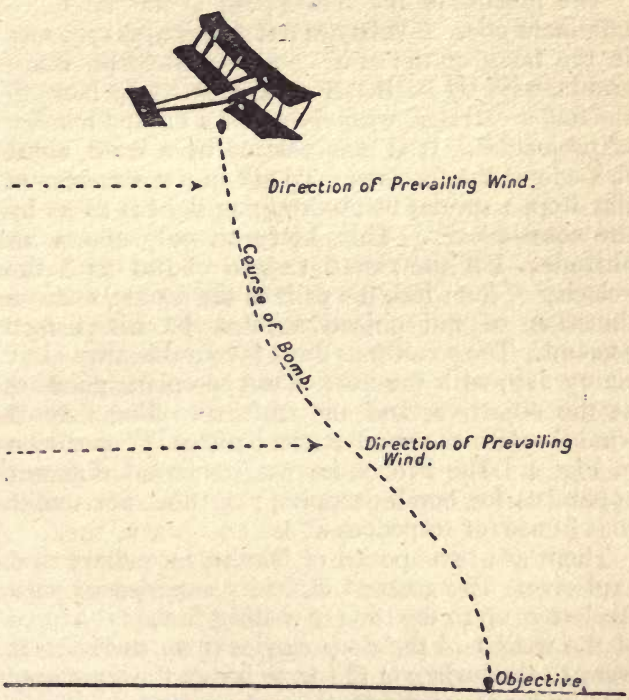

FIG. 4. HOW BOMBS ARE DROPPED FROM AIRCRAFT
(Showing the course of the falling projectile.)

place them in a stationary position and cross two guns, with the muzzles at some twenty degrees distance, and firing automatically. Thus the bottom gun would open fire at a range of 7000 feet. The airman would immediately climb higher, only to find himself within range of the upper gun.

Again, for night firing, a searchlight and a gun would be fixed side by side, so that no unnecessary time would be lost in getting the range once the objective had been picked up by the light.

The matter of bomb-dropping is not an indiscriminate one. Bombs are not taken up haphazard in the body of the craft, and hurled forth, indiscriminately, by hand. A rack is fitted up beneath the under-carriage, with clasps for a limited number of projectiles. It is manipulated by a lever, along the side of the fuselage. To aid in the accuracy of the drop, a special bomb-dropping sight is fitted by the control-lever. This, however, only allows for altitude. For the rest the speed of the craft, the velocity of the wind, the drift in the course, and the direction of the objective must be taken into account. The conditions most favourable are a clear sunny day, with the nose of the aeroplane pointing at the objective, and the craft travelling "down wind"—with the wind at the back of it—as shown in Fig. 4. The French have a somewhat different apparatus for bomb-dropping; a tube, not unlike that in use for torpedoes at sea!

There are two species of bombs, incendiary and explosive. The greatest difficulty experienced with the latter, up to the time of writing, is that the force of the weight of the drop carries them several feet beneath the surface of the earth before the detonator acts, and, as the force of the explosion is for the most part downward and lateral, the projectile loses considerable advantage in the matter of death and destruction.

Other forms of projectiles are the grenade, explosive dart, and, latest of all, the American aerial torpedo. In many respects this torpedo can be compared to the standard field-gun shell. For instance, the airman calculates the distance he is from his

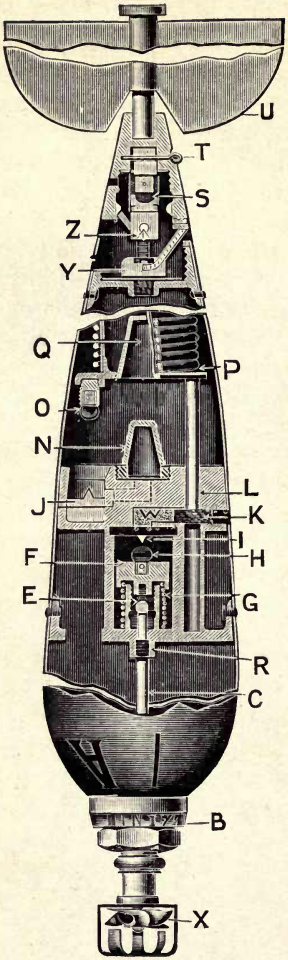

FIG. 5. SECTIONAL VIEW OF AERIAL TORPEDO, SHOWING THE TIME-FUSE AND THE CONTACT DETONATOR

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target and sets the nose of the torpedo opposite the graduated ring B (see Fig. 5), which corresponds to this distance. The bomb is then released and the momentum of the first 50 feet of descent fires the auxiliary primer N, this being accomplished by the rotary motion of the propeller X, mounted on the shaft C. The method by which this is brought about is ingenious. The propeller shaft, by means of the thread R, frees the spherical end of the stirrup cup-string E, the arms of which have until now been engaged in a recess in the cylinder wall. With nothing to hold it back the spring G forces the plunger F upward, bringing its primer H in contact with the firing-pin I.

The flame that results is carried through the vent W to the cylinder of plaited rope powder composition K. This in turn burns away releasing the plunger stem L, which is forced by the spring P into the chamber below. It is then and for the first time that the picric acid booster charge at V is incased around the detonator N, through the action of the spring P. Meanwhile the primer O has been brought in contact with the firing-pin J, and the flame is carried to the detonator by means of the long or shortened time trains determined by the setting of the nose of the torpedo. The explosion of the main charge follows as soon as the flame reaches the detonator.

Now supposing the pilot misjudged the distance of the target so that the setting of the time fuse would bring the explosion some time after the torpedo had reached its mark, which would probably mean that the torpedo would fail to accomplish its mission. It is to meet just such a condition that the present torpedo is also equipped with a contact detonator or impact detonator located in the rear of the stem. The firing-pin is seen at Z, the primer

at S, the safety-wire at T. The force of the detonator explosion is communicated to the main charge, and so at its worst the torpedo is as effective as the best contact exploding bomb. Lastly, U is a steering vane for guiding the torpedo towards its mark.

These torpedoes, tested by the American Army officials at Mineola, are known as the Barlow torpedo, and are made at the Frankford Arsenal. Quite naturally the details of this torpedo are being carefully guarded, although in its main essentials it probably follows the design of the torpedo described in the foregoing.

It must be understood that bomb-raids for the most part are strategical. The enemy aeroplane, seaplane, and Zeppelin raids are by no means wild eleventh-hour ventures, but part and parcel of the German general offensive. To each effort there accrues more than a small amount of danger; danger alike to craft that cost, in the case of the Zeppelin, roughly £240,000 apiece to construct, and to personnel, who require at least twelve months' preliminary training.

With the use of aircraft in war there are two results that can be attained: the one military, the other moral. Apparently the enemy hoped and expected to achieve both. Whether or not he was successful in his aim must be judged from the effects of each respective raid.

To a minor degree he did achieve a military result, which requires the bombardment or destruction of some military area, as the dropping of bombs on a dockyard, munition factory, barracks, harbour, fortress, or railway junction; or the serious dislocation of sea, railway, or road traffic. But moral result was entirely lacking.

This moral result is peculiarly adaptable to prevailing circumstances. In the case in point, the

enemy was burdened with the idea that he could introduce a state of panic and wholesale fear into the civilian population of this country. Again he failed miserably in the attempt.

That excellent institution The Hague Convention was thrust upon the world before the day of the aeroplane as a serious factor of war, but nevertheless there are several clauses therein contained which apply peculiarly to aerial bombardment. This code permits of the bombardment of the positions hitherto mentioned, but adds a proviso that notice must be given to allow non-combatants to reach a place of safety.

It should be noted, earlier in the war, in deference to the Convention our Admiralty officials stated in a communiqué that "Instructions are always issued to confine the attacks to points of military importance, and every effort is made by the flying officer to avoid dropping bombs on any residential portion of the towns."

Again, the question arises, that as London and other large areas are now defended by anti-aircraft artillery, are they still defenceless cities? As to the matter of warning in a Zeppelin or other raid, such a course would be ludicrous from the enemy's point of view, as the primary element of such a manœuvre is that of surprise.

Now, having discussed the *raison d'être*, let us turn our attention to the craft and the various methods they employ. The principal Zeppelin bases are situated at Heligoland, Kiel, Friedrichshaven, Munich, and Brussels, though it is extremely probable that the latter has long since been abandoned owing to its proximity to the Allied lines, and the Hun's well-merited fear of the Allied airmen. Each town is, roughly, 600 miles distant from Great Britain, and, with one exception, the distance

travelled is 90 per cent over the sea. This is a great drawback to raids, and until the Zeppelin is further developed, the North Sea will supply a useful natural defence.

Next in order comes the matter of weather. Rain, snow, or sleet obscures landmarks, and thus enhances the difficulties of navigation. With regard to rain particularly. Water is eight hundred times heavier than air, and interferes considerably with the buoyancy of the craft. Fog, for obvious reasons, renders flying impossible. With a moonlit background the Zeppelin is a prominent and easy target for the anti-aircraft gunners. Also there are various electrical disturbances in the air, extremely dangerous to gas-borne craft ; and high winds, those from the south, south-west, and west being particularly dangerous and choppy.

Allowing for this matter of weather, and a comparison of Zeppelin activities of former years, shows us that the most probable Zeppelin periods for 1917 are :—

April 14th–May 8th.
August 8th–August 18th.
September 9th–September 23rd.
October 7th–October 17th.
November 7th–November 15th.
December 7th–December 15th.

Setting out in the late afternoon, with a heavy load of bombs, petrol, etc., aboard, it is some little time before the Zeppelin is able to rise to anything like a decent altitude, although just previous to leaving the ground the ballonets have been pumped almost empty of weight-supplying air. The navigation of the craft is directed across the North Sea by submarines, that keep in contact by means of wireless communication.

Just before dusk, one or the other of the off-coast lightships is sighted, and immediately the craft rises to a great altitude.

Then the real dangers and difficulties of the trip commence. A flight over a darkened enemy country, plentifully supplied with anti-aircraft guns.

Whether the darkening of the towns adds to the difficulty of the navigation is a matter for the authorities to decide. Apparently they think so! But there are many natural landmarks that cannot be shrouded.

The return journey is a more ticklish enterprise. The North Sea has to be recrossed, this time in the inky blackness, and the Zeppelins have to hover up aloft until day breaks and a landing is possible.

The daylight aeroplane raid is another and considerably more dangerous phase. The latest German machines, and particularly the Halberstadt, with its 240 horse-power Benz engine, are capable of flying at an altitude of 15,000 feet and over. At such a height marks of nationality are extremely hard to distinguish, and a fast moving object makes a difficult target for the anti-aircraft gunners.

Day after day aeroplanes pass safely through anti-aircraft fire at a lesser altitude, with an average 8 per cent loss, across the firing-line. Why not over this country?

The solo attempt on London is but preliminary to raids on a larger and more extended scale. It is a prescient danger, and one that can only be avoided by a constant patrol of scouting British craft.

It is impossible to foretell to what limits the enemy may go when smarting under humiliating defeats on land and sea, and a gigantic and devastating aeroplane raid on London is by no means without the limit of his intentions.

But not so much the present war, it is the future

we must take into consideration. Germany's air fleets will always remain an unwelcome menace to our national safety.

In the past he did not scruple to send his hordes of soldiers swarming through Belgium without preliminary warning ; and in the future he will no less scruple over a sudden and gigantic air raid. For the first and most important element of aerial warfare is surprise.

To guard against this danger we must destroy Germany's air fleet at the earliest possible opportunity, and by retaliation carry the war into the enemy's country, to keep him there, busily engaged.

CHAPTER X

AERIAL COMBAT

"TWO German aeroplanes were brought down yesterday in air fighting," runs the terse, intelligible phrase that occurs almost daily in the British Official, with a possible variety in the number of casualties. The scene of action lies among the grey, racing clouds, across the shell-specked heavens, south to the horizon of the mottled-grey war area, north to the peaceful blue sweep that hides the white cliffs of Dover behind the morning mist. Creeping above the clouds are small, lithe forms, that plunge suddenly downward, like albatrosses, upon their unsuspecting prey; wheeling, turning, diving in that strange, thin air, two and three miles above the surface of the battlefield.

The highway of the air is broad and free; high crawl the powerful twin-engine battleplanes, that scour the skies for enemy craft, the lords of the heavens. Below them ride the slower and more cumbersome reconnaissance and raiding machines, convoyed on either side by strongly armed craft; here a "flight" directing artillery fire, there a squadron of fleet, bombing biplanes. Dawn and twilight the highway is awhirr with adventurous craft.

The highway, for the air is own cousin to the sea. The sinister craft that climb beneath the stars, and

the swaying specks of the daylight hours are the privateers of modern war. Their mission? None can say! Only the pilot knows, and he is master of his craft to wander where he will. But in flying logs we come across such quotations as mentioned by Beach Thomas in the *Daily Mail*: "A general engagement then took place. Two fleets swept up to give battle. Early in the action one of our pilots was severely wounded, but fought on and sunk an enemy ship. Later, when the first squadrons were well in action, the enemy brought up supports, raising the number of first-class vessels from six to ten, of which four were eventually sunk. The final flight of the enemy occurred upon the arrival of a single supporting ship from our side.

"A British pilot watching the sky from harbour saw the battle from afar and hurried his machine out, and, so quickly do these new craft climb, was just in time to take a hand in the fighting, in spite of a long journey of a climb of 12,000 feet. He himself shot down one of these enemy planes almost instantly, whereon the rest scattered and fled."

There must have been a great breath from the sea when aircraft first took the skies that swept rampant all the customs and traditions of the older Service into this prodigy of the war. For it was thoroughly human, typically British, and delightfully sporting. It was the code of the football field and of the cricket ground. A code from which the word defeat was entirely eliminated; where the mind shunned fear, and the will was hardened to all kind of mishap and adventure. In a word, it was to always fight clean and fair.

This untrained body—the Flying Corps—was developed with a thoroughness and rapidity that outdid even the magic Kitchener Armies. Resultingly, Britain very soon held the supremacy of the

air. This necessitates maintaining a ceaseless photographic reconnaissance far behind the enemy's trenches, to spot for the heavy guns along an extended front, and to "keep the wind up" the Boche so that for every ten British aeroplanes that crossed the German lines barely one of his would dare to cross ours.

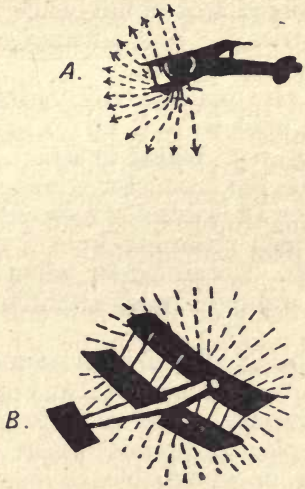


FIG. 6. RANGE OF MACHINE-GUN FIRE FROM AEROPLANES
(*a*) Limited. (*b*) Unlimited.

The future pilot was instructed by young, seasoned warriors of the early days, trained upon the fascinatingly narrated personal encounter and adventure. That training to-day is as comprehensive as beforetime it was haphazard.

A school of aerial gunnery has been established where practice from the air takes place against every form of target, both on the ground and in the air.

This matter of aerial gunnery is the most impor-

tant of all to the aerial fighter. And the possibilities of gunfire vary greatly with the type of craft. With some, an automatic control of the engine regulates the gun to firing between the revolving propeller blades. With others, again—with the engine at the rear—a yet greater field of fire is possible. This is best indicated in Fig. 6, where we discover (A) has a restricted area of fire, while that of (B) is entirely unrestricted. The advantage of (A) over (B) can hardly be imagined.

Fighting is also practised by various methods; two machines may be sent up to manœuvre one against another, both trying to attack, or the pupil is sent up while the instructor tries to attack him, or vice versa, or an instructor goes out and attacks a group of pupils returning from a cross-country flight, and so on. The air fighter, when fully trained, is a specialist, and confines his attention to this type of work alone.

Apart from being a useful pilot he must be able to read maps, fire machine-guns, and send wireless messages accurately. Risks and adventures he will encounter in plenty, against which he must be endowed with imperturbable courage and great initiative. It is the unexpected that invariably carries the aerial combat; the manœuvre for which one's opponent is unprepared.

A naval pilot flying a Nieuport—the terrible "baby" of the skies—ten miles out from the shores of the North Sea, and when approaching Ostend, at about 12,000 feet, encountered a German seaplane. The latter had glimpsed him from afar, and manœuvred into a position behind and below his course. Too late the British airman was aware of his proximity, and, in an endeavour to retrieve himself, executed a steep glide over the enemy, who passed underneath. Thus he gained the desired position

and opened fire at a range of 100 yards. The enemy machine burst into flames, falling headlong to the ground. By unexpectedly looping he was able to convert a possible defeat into a certain victory.

A brother pilot, on six different occasions in one flight, attacked and drove off hostile aircraft which threatened the bombing machines that he was escorting, one enemy machine going down.

On another occasion a British airman, unable to reach his opponent by any other method, charged him direct from a short distance. The German, who must have been a cool fellow, kept a perfect bee-line to the end, apparently seeking mutual destruction. Our pilot turned at the last moment and rammed, not the centre, but the right wing of the opposing craft, which he carried away, and the German plane fell, helpless, to the ground. The British machine was badly damaged, but still airworthy, and the engines carried it wobbling but safely into harbour.

Aerial combat requires a special class of aeroplane, with a powerful engine, rapid in its movements, and fast to climb. The best types are either a fast single-seater fighting plane, a double-engine battleplane, or, latest of all, a triplane—triple-decker aeroplane.

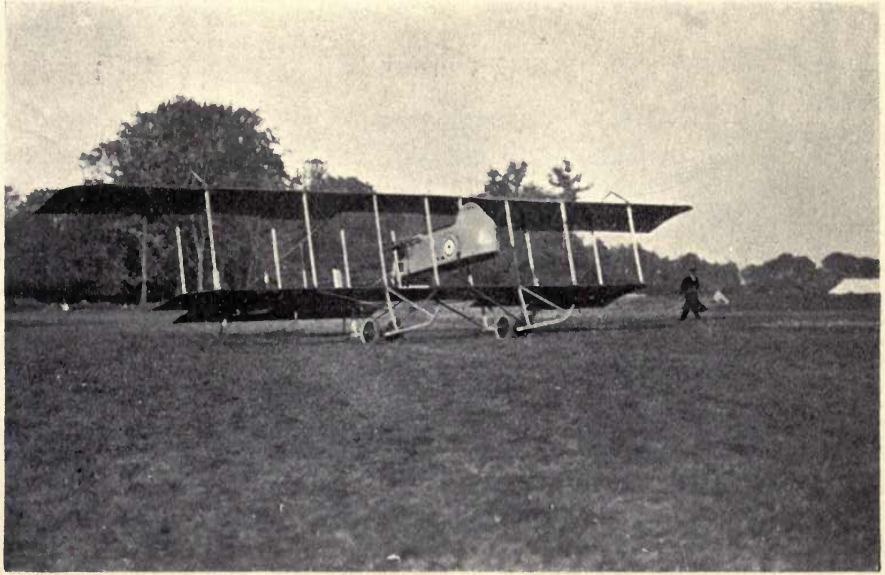
It must be realized that one of these craft, whether British or German, can do what it pleases with most of the planes designed for observation or photography. They are like destroyers as compared with merchant vessels. The air being the big place it is, a good number of these more cumbrous craft must necessarily fall victims to the fighting ships whosoever rules the air. Most of our losses are among this unwarlike flotilla. Of course, these slower, clumsier craft can give an account of themselves, but they

have little chance at the best against the pace and climbing power of a heavily armed vessel.

The ethics of aerial combat are the simplest and oldest in the world. For as many centuries as there is history, the winged denizens of the skies have been giving valuable demonstrations. Watch two common or garden sparrows; the fight develops, upward—upward—upward. All the time both opponents are struggling for the upper berth. An air fight differs in no respect. The back is the human's most defenceless spot. Above and behind is the best position in aerial combat. An air pilot with a rakish machine-gunfire pouring into his nethermost parts is helpless. He might well, as a Hun humorist did recently, hold aloft his arms, with a despairing "Kamerad." It is his only chance to escape a drop of some thousand feet and death.

The air fight is the sole relic of old-time romantic warfare. It is a matter of wits and courage, strength and endurance to the end. Those modern knights ride their petrol steeds, with their gun-lances atilt their shoulders, in the lists of the clouds and boundless eternity, with the smiling Queen of Victory awaiting their victorious return below. Her name is no commonplace feminine equivalent, but the proud cognomen Duty.

Of these graceful duels one cannot forbear to mention the affair of Rouzier Dorcières, a personality famous in two continents; a composite of Cyrano de Bergerac and d'Artagnan. Dorcières was premier duellist of the great Republic across the Channel. More than a score of victorious duels could he claim. But the greatest was in the clouds, the last—fought not for self-glory, but for the honour of his beloved France. The story was quoted in a recent number of the *Weekly Dispatch*.



OLD TYPE FIGHTING CRAFT

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Wherever Dorcières travelled, his reputation preceded him. At Zurich, in 1910, he was publicly insulted by an officer of the Prussian Guards. The latter approached him after dinner, as Dorcières was sipping his coffee in the lounge.

"So you are Rouzier Dorcières?" he said sneeringly. "I recognize you. And they say you have never been touched in a duel. Well, I am sorry I have never had the good fortune to meet you in one."

"But you will have the chance to meet me," replied Dorcières heatedly.

The Prussian's expression grew dark. "Monsieur," he said, "I shall meet you here before ten o'clock with my seconds and the swords. We will settle this affair before I depart. Will you await me?"

The duellist waited, but no Prussian appeared. He had departed hurriedly. And from that evening he registered a mental vow to obtain satisfaction from his cowardly assailant, somewhere, sometime, somehow.

With this object he enlisted in the French Air Service on the outbreak of war. Said his pilot of Rouzier Dorcières:—

"He was the strangest machine gunner I ever had. Unlike other gunners, he always carried binoculars, and when we sighted and approached a Boche he spent his time in peering intently at the occupants of the enemy machine instead of preparing his mitrailleuse anxiously as most gunners do.

"As we circled near the German machine in his last fight, Dorcières passed me a scrap of paper. On it he had scrawled a request that I swoop past the German as near as I could. Instantly I divined his reason—and his reason for always carrying and using his high-power glasses. He thought he

recognized one of the occupants of the other aeroplane.

"Our fuselage cracked and splintered as the leaden hail perforated the car, and the choking gasps that I heard behind me were the positive indications that my gunner had been hit. I turned upward, as my motor was undamaged, and climbed with the German. Then we both planed and approached each other, and the test was which of the two machine-gunners would prove to be the better man.

"Dorcières's first shot at the new elevation must have killed the enemy gunner. And his torrent of bullets ripped off the tail of the Fokker and it dived into our lines like a stone, nose down.

"I piqued down, too, and landed within fifty yards of the broken Boche car and its occupants. Two stretchers were waiting there for us, but I was unhurt, miraculously. We put Dorcières in one, tenderly as a baby, and then started off. But he had seen the wreck of the Fokker there and he begged that we stop beside it.

"Beside the German machine were the pilot and the gunner, both dead. By a superhuman effort my dying gunner raised himself on his elbow. He gazed at the battered dead face of the enemy machine-gunner.

"'It is he,' was all he said. And we carried him to the field hospital."

The principal methods of aerial attack are the dropping of incendiary and explosive bombs, the use of firearms, as a Remington or Winchester repeater—now almost extinct—the dropping of hand-grenades, and, more effective than any, the use of the Lewis machine-gun.

This gun fires through the blades of the propeller, which deflect at least 5 per cent of the bullets; thus firing is a one-man job. The difficulty for a

man to pilot and fire at the same time is beyond comprehension; two men at least are required, the one to direct the course of the craft on to the object, the other to fire the gun.

Another important matter is to obtain a suitable mounting for the gun, namely, one that allows the largest possible angle of elevation and depression. The advantage accruing to a machine with an area of gunfire that includes every position and angle is enormous. The best direction to fire the gun depends largely on the type of machine. Suiting the machine to the gun, the "pusher," with propeller in the rear, offers a clear bow. The "tractor" is impeded by the propeller blades and the limited space in which the gunner has to work.

Next in importance is the matter of manœuvring. When giving chase to another machine the pilot must always keep his enemy in view; his own machine, as much as possible, out of sight. Once he takes his eyes off the enemy in mid-air, he is apt to lose sight of him altogether. He must always endeavour to place himself between the enemy and the sun, and always keep him on the gunner's left hand. Finally, he must always turn toward the enemy, never away from him.

Entering into the actual combat is, by nature, more of a tactical manœuvre. As yet it is on too minor a scale to be classed as strategical. That is with the exception of the one great fight of March, 1917, when five British aeroplanes fought twenty-seven Germans, and sent eight to earth, crippled or in flames.

It was a day of great heat. There was a haze so thick that the ground was barely visible. Our men started late in the afternoon, and at five o'clock were well over the enemy country when, with the sun at their backs, they saw two enemy machines ahead.

They endeavoured to close, the enemy making some show of fighting. However, it was only a show, for as our leading machines drew near the Germans turned and made with all speed for home. Our machines gave chase and were led into a decoy. Out of the haze and void on all sides new fleets came closing in. The new arrivals flew in three formations, two of which contained eight machines, the other nine, making twenty-five craft in all, to whom the other two, which now ceased to run away, joined themselves, making a minimum of twenty-seven machines in all.

One of the enemy fleets, taking advantage of the thick air, had passed behind our little squadron and came at it, as from the direction of our own lines, straight between it and the sun—an awkward direction. The other fleets came from the north and south-east. As they approached they spread out so that our men were ringed around with enemies on every side.

The order to attack, though given, was hardly needed. Each one of our five turned at once for the enemy who was nearest. The fight began at about 11,000 feet, but in the course of the things that followed it ranged anywhere from 3000 to 12,000 up and down the ladders of heaven. And an extraordinary fact is that, all the while that it went on, the German anti-aircraft guns below kept at work. Usually, as soon as aeroplanes engage overhead, the "Archies" are silent for fear of hitting the wrong man.

Such a general mêlée inevitably breaks up into a series of individual fights. "Formation," as it is technically known, breaks up, but nothing could have surpassed the way in which our men fought. Not one of them ever allowed himself to be cut off and isolated from the rest. Not one failed to be

ready when a friend was in imminent danger to turn to his assistance. This is the more remarkable as, with the exception of the Flight Leader, all the pilots were practically new men, with little experience of fighting. Some had only been in France a fortnight. Yet no veterans could have exceeded these youngsters in coolness and fighting judgment. As for the Flight Commander himself, he, still a youth, may fairly be called a veteran, for in that battle he reached his seventeenth German victim.

During the course of the fight, one of our machines plunged down with flames bursting from its reserve petrol tank. An enemy, glimpsing an easy quarry, dived for the flaming ruin as it fell, but, quicker than he, a comrade plunged down to his aid. And while our crippled machine, still belching flames, slid off, with its nose set for home, the German, mortally hit, dropped like a stone.

Strangely enough, our burning aeroplane got home. The wreckage was a pitiful sight to view; with the reserve petrol tank on the roof bearing two bullet holes on one side, and great ragged tears on the other where the bullets passed out. The whole tank was scorched and crumpled. The flames had burnt away the whole central span of the upper plane. Yet, like a great blazing meteor, it crossed our lines and came to earth, not indeed at its own home, but on safe and friendly ground; and as another airman said in admiration, "He made a topping landing."

The "Archie"—anti-aircraft shell—is the worst enemy a fighting airman has to face. There is a natural and not to be wondered at enmity between our aeroplanes and the anti-aircraft guns of the Germans. Though one must not imagine that a British aeroplane takes a straffing from Archie as a matter of course. Time after time they have

shown their resentment by diving at the presumptuous batteries and scattering their crews with rapid bursts of machine-gun bullets, just as by night they have dived at searchlights behind the German lines. Here the simile ends, however, for instead of being singed the planes have shot and bombed the lights to darkness.

Dawn is breaking when No. 4 returns, tired-eyed and more monosyllabic than ever. It came off all right, but No. 3 had seemed to lose control and slide down the beam of a searchlight with shell and balls of red fire (some new stunt, he supposed) bursting all about her. However, she got her bombs off first, and touched up something that sent a flame 200 feet into the air. He himself bombed a group of searchlights that were annoying him, and some trucks in a railway siding. The speaker has an ugly shrapnel wound in the thigh, and observes with grave humour that his boots are full of blood—this is a Navy joke by the way. Also that he could do with a drink.

But it came off all right.

Since our aerial offensive began the Germans have rushed many anti-aircraft batteries to the Western Front in an effort to check the care-free manner with which we cross their line. They are barking all through the day and often far into the night. One of these new batteries, larger and noisier than most of its truculent brothers, incurred the special disfavour of a certain squadron a short time ago; not that it was doing any particular damage to anything or anybody, but it was just deemed too blatant and noisy to exist any longer. So the squadron flew up one bright afternoon, drew the fire of the battery, then closed in upon it, and let go with 124 bombs.

British pilots, when they get peevish, rather like

having a go at the guns. When they get tossed about by a too-familiar big howitzer shell hurling by in the air, it is not an uncommon thing for them to hunt down the annoying gun and admonish it to better manners in the convincing lexicon of the Lewis gun.

The most thrilling combat of the war occurred between six British scouts and eight Germans. It was an affair of wits as well as machines.

In the evening, towards sunset—about eight o'clock, to be precise—skirting the low-lying, dark grey clouds, there crept the British patrol, like a covey of wild ducks winging home to roost. Over the firing lines they passed, almost unnoticed. When well into the enemy's country they encountered the German craft. The latter fled hurriedly. Our machines gave chase, eventually overtaking them.

The battle closed in, growing furious. Wings scraped wings, and the fighting pilots could look each other squarely in the eyes. The leading British machine dived at the nearest German. The latter went down 4000 feet, in a spin, hopelessly out of control.

Out of the mêlée there plunged two craft, one above the other, driving him down. The harassed machine was British. Immediately one of his comrades, having despatched the machine with which he had been engaged, dived down to his rescue. The enemy was too intent on his prey to notice the British machine at the back of him. With a single tray of ammunition he went down, falling over and over.

Another pilot of the patrol, meantime, had attacked two enemy planes that were in the downward procession started by the leader. The first one of these soon cried enough, and cleared away

to the east, and having got on to the second aircraft's tail, he drove him down with a spin, but later he seemed to flatten out and, in the language of the corps, "was apparently all O.K." The British pilot was pretty close to the ground now, so he turned and climbed to 9000 feet, where he attacked another German, and the two fought all the way down to 4000 feet, when the German, with a riddled machine, went plunging downward to an inevitable crash.

The greatest of all British fighting airmen was the late Captain Ball, V.C., D.S.O., M.C., a short, lithe, monosyllabic youth in the early twenties. This splendid pilot had brought down no fewer than forty-three enemy aeroplanes and one captive balloon, and figured in countless adventures. He was the "Scarlet Pimpernel" of the air, always waiting, waiting above the clouds and mist, over the enemy's country. Below, British aeroplanes would suddenly be attacked in overwhelming numbers. Down would come the avenger with a mighty sweep, and the enemy would clear off, pell-mell. For his craft and manner of handling it were known and respected by friend and foe alike.

Captain Ball first achieved fame when on escort duty to a bombing raid. Returning, after a useful morning's work, they encountered four enemy battleplanes in formation. His was the only fighting craft of the patrol, but he immediately dashed forward to give battle. The enemy waited the onslaught with dignified self-assurance. When, suddenly, they found this "mad" Britisher was performing the most unusual manœuvres over their heads. Flying by a rapid mental calculation—as was invariably his rule—he had realised that, hopelessly outnumbered though he was, he could yet save himself, and the machines in his charge, if he could

climb to a certain position. This he proceeded to do, first baffling the enemy with a series of most unusual turns and dives.

At last he had climbed to the necessary altitude, and diving down on them broke up their formation in hopeless disorder, engaging hotly with the nearest enemy craft. The latter plunged earthward, wreathed in smoke and flame. Ball followed to within 500 feet of the mouth of the German guns, to make sure it was wrecked.

Further on they encountered a large patrol of twelve German machines. Before giving the enemy time to think out a possible offensive, he repeated his former tactics, again breaking them up, and driving one down. One against twelve! Enemy reinforcements came speeding up. Turning, climbing, wheeling, diving suddenly this way, suddenly that, the tiny British machine kept them all at bay, and drove another, flaming, to the ground.

On another occasion he attacked a group of seven enemy machines single-handed. The leading machine he shot down, and went after the others, which were retiring hastily. Within ten yards of another enemy machine he opened rapid fire and brought him down on to the roof of a house in a village in our lines. He then returned to his aerodrome for more ammunition, and encountered three more fighting planes. These he drove to the ground in rapid succession. When, finally, his day's work was completed, he glided home, his craft riddled from nose to tail with over three hundred bullet holes.

Towards the end, the enemy, who both feared and respected this daring airman, laid many traps for his destruction. Far from avoiding them, however, he deliberately went out of his way to match his wits against theirs, always returning unscathed, and,

from being the victim, added further victims to his own ever-growing total.

Almost the last aerial battle in which Captain Ball took part occurred when he was out with a patrol squadron, which encountered a German machine, and riddling it with bullets, drove it down.

Described by the correspondent of the *Evening Standard*, it read as follows:—

"Four red Albatross machines then came up, and a brother officer of Captain Ball, who may be called Captain X——, engaged one of them at close range. The German manœuvred for a favourable position, and his opponent dived and shook him off. Climbing again, Captain X—— pursued another of the red enemy squadron, and fought it for a considerable time, the German machine being outmanœuvred and sent crashing to earth.

"Then Captain X—— engaged a third machine, but he was shot through the wrist, and the top of his control lever was carried away. Although suffering great pain and further handicapped by the damage to his aeroplane, he succeeded in landing in the British lines without further injury, and then fainted."

Captain Ball had many thrilling fights during those last few days, bringing down three enemy machines and putting many others to flight. One day, while patrolling, he sighted two hostile craft, and as he was fairly low, he flew away from them, climbing steadily. When the German aeroplanes were quite near his tail he swerved sharply, slid underneath one of his opponents, and turned on his machine-gun. The German fell out of control.

He then manœuvred in order to attack the second enemy machine, but it flew straight at him, firing steadily. Captain Ball returned the fire as the

German came full tilt at him, and a collision seemed inevitable, when the hostile machine suddenly went down. The engine of Captain Ball's machine was hit and the pilot drenched with oil.

No other hostile aircraft were in sight, so he dropped and saw both German aeroplanes lying completely wrecked within four hundred yards of each other.

As he came home he fell in with two other hostile aircraft, but as his ammunition was exhausted and his sights covered with oil, he reluctantly "put his nose down" and returned to his aerodrome.

Last seen, Captain Ball was disappearing over the Hun lines in the fading light.

CHAPTER XI

WIRELESS AND DIRECTION OF ARTILLERY FIRE

THE value of aerial artillery direction may best be judged by the value of artillery in the war. The latter has invariably paved the way for the infantry and cavalry attack. To make a forward movement with infantry in these days of highly developed scientific weapons without a preliminary artillery bombardment would be to court disaster.

The accuracy of such bombardment is essential; thus it was at Mons and the Marne, where the hordes of German soldiery failed to force back our thin, exhausted lines; the latter gave way, step by step, in face of a murderous artillery fire. Back and back until our aircraft began to make themselves felt, and the French airmen became largely responsible by reason of the wonderful work of the famous ·75's.

Principally this matter must be judged from the point of view of the gunner on the ground, and the difficulties and disadvantages that he must contend with. In all previous wars it was the custom with guns with a range of above three miles, the target of which was not visible from the firing position, to send an observer, or observers, up to some point of vantage, preferably a church tower, or the roof of a tall building as near the object to be fired upon as

safety would permit. This task of observation was often both dangerous and difficult, and, when no suitable observation post could be discovered, impossible. Thus the firing of the guns became purely a matter of mathematics and judgment; the gunner being unable to discern whether the shells fired were near or wide of the mark, a thoroughly unsatisfactory arrangement to all concerned. It was then suggested that aeroplanes should be utilized for the purposes of observation. This has since become the main duty of aircraft along the battle front, and the direction of artillery has been a veritable triumph for the "Fourth Arm," employing daily countless pilots and machines.

For the direction of artillery the observer is generally responsible. Following the shell bursts on the map, he wirelesses their positions back to the gun-post and corrects the range. Together with the direction may be classed the observation of artillery. While out directing our own fire, an airman might very possibly spot one or a group of enemy heavy guns. Then it is a simple matter for him, knowing his own altitude, to gauge, by geometrical bearings, their position, and control the range of fire upon them.

On the Western Front the victory or defeat, the good or bad day fluctuates with the command of the air. This passes from one side to the other with a pendulum-like regularity; now the enemy, now ourselves; then the enemy, then ourselves. Immediately the enemy has lost the command his aircraft are conspicuous by their absence. Regaining that command they come swarming overhead in droves. Then is an anxious time for the men in the trenches. If a Hun aeroplane appears overhead—that is to say, over an important or vulnerable spot—it is followed almost immediately by a violent artillery bom-

bardment. The advent of enemy aircraft necessitates the immediate taking of cover. Of course, many of the more important positions are hidden or distorted out of their original appearance; and at this art again the enemy excels. His subterfuges are as numerous as they are ingenious. And not alone hidden positions, but false markings and dummy guns, also traps of anti-aircraft guns for the unwary airman. For this purpose a dummy battery of heavy guns or an ammunition dump is rigged up. Down comes the airman, thinking he has made a coup, to find himself, often too late, within a barrage fire of A.A. guns.

This class of work is confined for the most part to daylight. Occasionally a night stunt does take place, but the matter of observation and of communication is rendered doubly difficult. The only practicable way of communicating is by means of a Very's pistol. Several of the later craft have small searchlights aboard; which brings us to the matter of aerial signalling.

Of these there are two methods. The one we may say is audible, the other visible. Under these two categories come flags, which can only be read from a very short distance, telephones in captive balloons, smoke-bombs which leave a trail of black or white smoke, according to climatic conditions and, with the enemy, a handful of tinsel, which in falling glitters in the sunlight. The smoke signal is the most reliable.

Again, the enemy have a method of signalling with a powerful horn similar to the one in use on a motor-car, worked upon the siren principle. And last, and most important, there is the wireless instrument.

A wireless transmitting apparatus with a Morse sending key attached is fitted in each machine. An

observer is shipped, and away goes the pilot to "sit" over the target. This sitting business is a matter of first attaining a great altitude, then gradually spiralling down with wide circles over the object or area to be shelled. Meanwhile the battery opens fire, and the observer, after each shell has burst, signals to the wireless receiving station by the gun: Hit, over, under, left or right as the case may be.

The results thus obtained are little short of marvellous, both in regard to the prevention of the wastage of shells and the development of greater accuracy in firing. On a good clear morning it is no uncommon sight to see as many as ten aeroplanes all hovering over various points on the Front, target registering, and it speaks volumes for the efficiency of the wireless operators and erectors that, although so many machines would be in the air at the same time, they never jammed each other's signals.

The extreme advantage of this method of communication may well be judged from a cutting of a recent number of the *Wireless World*. Said that excellent journal:—

"One very excellent way of learning what one owes to a certain instrument is to do without it for a while. We get a good insight into the utility of aeroplane wireless from an account recently sent home by a newspaper correspondent. It is concerned with the adventures of a subaltern in the Flying Corps who was serving in Mesopotamia at a time when he was 'monarch of all he surveyed' (i.e. when his was the only plane available). He was scouting on a machine unfitted with radio apparatus, and, as soon as he went up, noticed how at a certain height he ceased to be troubled by the shimmering mirage which in hot climates confuses the human

eye and judgment of distance so long as the observer is located on the earth level. From his vantage point in the sky everything was 'clear as a bell.'

"Yonder go our cavalry and the enemy's, nearing each other in the haze totally unawares! . . . What's ——'s brigade wheeling round for now? A mile further advance would turn the enemy's flank. . . . The Turks are leaving their front trenches; they're fully 3000 strong: oh, if only I could get our gunners to shell them from across the river. . . . Now's the time; if only the cavalry would go for them! . . . What a chance they've missed!

"Matters have been amended now, and the British air ascendancy in Mesopotamia is at present as complete as it is in France. The machines are of the latest pattern, and aeroplane wireless keeps the pilots and observers in the sky in close touch with the artillery commanders and army leaders beneath them. The erection of hangars has reduced the wastage of aircraft by giving protection against the alternate sun-baking and rain-drenching to which the machines were subjected in the earlier stages of the campaign.

"The scraps of the flying man's remarks, from which we have just quoted, speak eloquently of missed opportunities which would not have been let slip had wireless been available."

By the gun position a special operator is always waiting at the receiving station, also an officer to take the range.

The receiving station?

Imagine, if you can, a peaceful group of farmhouses and outbuildings; on either side are the grazing meadows and, perhaps, a duck-pond or so. Slovenly, unkempt-looking women are lounging in the doorways of the cottages, stolidly regarding the

movements of the artillerymen gathered round that black, ugly-looking barrel that rears itself from amidst a pile of screening tree-branches and foliage in a near-by meadow. An aeroplane passes swiftly overhead. Immediately half a hundred pairs of eyes are focussed thereon. A hasty consultation, then the gun is laid, the range gauged, and the wireless operator ordered to stand by! He assembles his set among the bales of straw in a barn, claps on the head-receivers—and waits.

The signal is not long in coming. Birr—birr—birr; Siz—siz—siz go the 'phones over his ears. He informs the officer by the gun that the attendant aircraft is ready and waiting. Boom! goes the gun. One of the gunners hurries across to the wireless man. Birr—birr—birr go the 'phones again. "Last shot over," he translates. The gun fires again and again. This is a matter of extreme importance; the gun must be fired as rapidly as possible in order to enable the airman to give the correct range.

So they go on. Now the wireless signal is over the target. Now short of the target; now to the left, now to the right—and at last correct. The gunners have got the range, and proceed forthwith to pound shells into the unsuspecting Boches for all they're worth.

Despite this extreme usefulness of wireless in aircraft, it has at present one serious disadvantage. The earth for the set has to be obtained from the metal of the engine, and does not permit of too large a radius. Thus, though it is a comparatively simple matter to send signals over a distance of twenty miles from the aeroplane, it is usually impossible to receive signals over distances of over two miles. Such signals as are employed can be picked up with equal facility by friend and foe alike. That is to say, if the receiving instrument is "tuned up" to the

same range. Again, with so many different instruments working, at one and the same time, in a small area, it is very possible that "jamming" will occur.

The noise of the constantly running engine is another difficulty to be contended with. This renders it exceedingly difficult to hear the signals in the telephones.

The aerial of the set is stowed away upon a large round wheel at the side of the fuselage, from which it is paid out in similar fashion to an anchor. But it has to be all rewound within 200 feet of the ground, as with the then tilted altitude of the craft there is a constant danger of its fouling the propeller.

The weight of the entire set is limited to 100 lbs. Necessarily this entails very little power and an extremely limited radius; *per contra* a great radius requires considerable power, and considerable power requires a large and weighty wireless set, which would be impossible in an aeroplane.

The wireless receiving stations are situated either on large and powerful motor-lorries, with a mast for the aerial, or in dips and hollows in the ground, so that they may be sheltered from the enemy.

Wireless is most important in Zeppelins. But the instrument must be well protected, owing to the danger of the spark igniting the gas. The entire instrument is more satisfactory, as it is possible to obtain a good earth from the huge metal framework of the craft. But this framework, which is, for the most part, constructed of aluminium, presents another danger, as it is a great collector of electricity. The value of wireless work with these lighter-than-air craft is dealt with to some extent in another chapter.

Finally, aviation has done a lot to help forward and develop wireless experimental work, in that it has introduced it into an entirely novel and hitherto undeveloped sphere.

CHAPTER XII

KITE-BALLOONS AND PARACHUTES

THE observation balloon—to-day an ungainly creature that sits always tailwise in mid-air—is not a product of this war. Its history dates back to the late eighteenth century. In 1794 Coulette presented the first war balloon to the French Government, and it was employed against the Austrians, who considered it an insidious form of attack, and declared that all balloonists who fell into their hands would be treated as spies forthwith.

Aircraft played a more than important part in the Franco-Prussian war of 1870–1. Jansen, the celebrated astronomer, who was interned in Paris, was desirous of reaching Algiers by December 22 to witness a phenomenal eclipse of the sun. The English offered to procure for him a safety permit through the German lines, but this he declined, and elected to effect his escape by balloon. He accomplished this feat on December 2, landing the next day some sixty-five miles south-west of the capital.

Subsequently numerous balloon sorties through the air greatly annoyed the German military commanders, and orders were given forthwith to Krupp to construct the first "Archibald" gun. This weapon was mounted on a specially constructed gun-carriage, and was capable of being tilted to almost any angle; but no instance is on record of a target being registered.

The original captive balloons were spherical in shape. The present-day craft, the kite-balloon, is more useful than ornamental. It was proposed by a Scotsman, Archibald Douglas, as far back as 1845, but two Germans, Colonel von Parseval and Dr. Kriegsfeld, first constructed one of these strange craft in Augsburg. The captive spherical was soon discovered to be impracticable for war purposes. In any wind of over twenty miles an hour it rolled about to such a degree as to make accurate observation impossible. Thus we have the present peculiar shape.

The two main portions of the craft are the envelope and the car. The former is the balloon portion which is filled with gas and provides the necessary lifting power. The latter, strung below the envelope by means of the rigging, is a large basket capable of housing a crew of two, with maps and other necessary paraphernalia. The main idea of the craft is that it sets itself diagonally like a kite to the direction of the breeze. It is serviceable in a wind of up to a velocity of forty miles an hour.

The only remaining portion of the craft is the steering-bag, a strange excrescence under the hinder lower parts. The function of this bag is to keep the balloon head on to the wind. The air enters the steering-bag and passes by means of another valve into the air-bag whenever the pressure in the latter falls below normal. Thus the air-bag is constantly kept tight, and so solidifies the whole balloon.

To hold it in captivity the balloon is connected by a light and durable steel cable to a steam winch on the ground below. This cable was originally attached to only one point of the rigging. With the later kite balloons, however, it was found more expedient to connect it at two different points, thus

always holding the craft at an angle of between thirty and forty degrees to the horizontal.

Behind and below the main body there hangs a long ungainly tail of six small parachutes. The purpose of this tail is to anchor the craft against any sudden gust of wind, which would be extremely dangerous to the observers in the basket and liable to tilt them out.

The military function of the balloon is observation. In the car are two observers. Before them are two specially prepared, squared maps of the district under observation. The car is connected to the winch by telephone, which passes down through insulated wires in the strands of the cable. From the winch, again, connection is made across country by the usual telephone wires to the group of heavy guns for which the balloon is spotting. Thus the gunner, by his battery, will telephone to the spotter above, and often four or five miles away, when he is ready to start. The observer gives the required signal. The gun is fired. The smoke clears away; through his glasses the observer has noticed the position of the burst. He gets through to the gun again. "Your last shot was over," he says, or under, or so much to the left, or so much to the right, as the case may be. The gunner remedies his error and fires. Again he inquires of the observer. Then possibly the reply may come. "Dead on that time. Go ahead."

At sea, observation balloons are, if anything, more useful. When not in use they are stowed away in the hold of the parent ship. Then they are let up in precisely the same manner as their brethren ashore. In the Dardanelles they were in commission continuously: one "sausage" spotting for the *Queen Elizabeth* when she was firing from one side of the peninsula to the other.

The K.B., however, is the most harmless and easily attacked of aircraft. The gas in the envelope prevents the employment of arms of any description. When the enemy aeroplane flies up overhead with intent to bomb, there are two courses open to the crew. Either to have the craft rewound on to the winch on the ground; the other, to take to the parachutes. A parachute drop is generally the last resource. When all other means have failed, the pilot, in desperation, takes to those few closely-folded feet of silk and cord. It is by no means a pleasant experience! One feels that the plane or, as the case is, the kite-balloon one is about to leave is endowed with all the safety of terra-firma when compared with the bottomless void into which one plunges down—down to where? Will the parachute open, or has the cording got entangled, or the body jammed? Those few seconds are a lifetime. With the assurance that it would open, a parachute drop would be no more terrifying than an ordinary flight through the air. With nothing below and very little above, a pilot could well appreciate the situation if the sides and bottom of the body of his machine had been cut away, likewise the cowl, the engine, the undercarriage, and the wings, and nothing but his seat remained.

However, with all its terrors the war has necessitated the revival of the parachute. And, from the occasional Press accounts that are allowed to filter through, it is apparently doing excellent service on the other side. But the parachute is no modern invention. In the history of its development are numbered such prominent pioneers as Leonardo da Vinci, Fauste, also Joseph Montgolfier: prior to his balloon experiments Lenormand made a descent from a tree as long since as 1783, but confined his

further experiments to animals. Blanchard was the first to take the matter up as a profession, and made a very considerable sum of money thereby. And Garnerin, on October 22, 1797, made a drop of 3000 feet from a balloon. Since those days the parachute drop has usually featured as the *pièce de résistance* of the country fair or the public exhibition.

When leaving the craft the aviator drops like a stone a distance of some sixty or eighty feet before the parachute opens. And, curious to relate, the greater his weight, the sooner the parachute unfolds. Then its course follows the fashion of the bend in the letter L.

It is the rush of the upward currents of air that is responsible for the action, and the strength thereof, as may be judged, is tremendous. The speed of the drop, on a general estimation, is four feet nine inches per second. Thus Robertson took thirty-five minutes to drop 10,000 feet. But, on the other hand, Frau Poitevin, a German parachutist, made a drop of only 6000 feet in over forty-five minutes. This depends, to a very great extent, on the weather conditions prevailing.

The feelings experienced are varied. Some say there is a sort of numbness: a blank in the mind from the second that the parachute leaves the craft until the time when it opens: others, that after it is all over nothing but a horrible nightmare remains; and yet others, the feelings experienced are similar to those in a high dive.

Talking to one of the best known of our pilots, and one who has made many drops, he explained that the feeling was composed half of horror, half of joy: horror at the entirely novel sensation of the dead drop, joy to think of what one had accomplished. But, he confessed, he never made a drop

from any sense of pleasure. And whether one fears it or no depends largely on the mood one is experiencing at the time as well as on the temperamental fitness on the whole of the one making the experiment.

The highest drop recorded in this country was one of 10,500 feet made by Wing-Commander Maitland over London: the lowest, and incidentally the world's record, one of 350 feet made by Sir Bryan Leighton.

There is a considerable difference in dropping out of a balloon and an aeroplane. With the former it is a comparatively simple matter of stepping over the side. With the latter, however, one has perforce to scramble out of one's seat in the body, and gingerly, very gingerly, climb out on to the wing, there to be blown off by the backward current of air. An airship, having a moderately steady motion, and possessing the property of being able to hover in mid-air, renders parachuting the simplest of matters.

Of the three forms of craft, drops have rarely been made from aeroplanes, a few only from airships, but quite a number from kite-balloons. As a matter of fact, with the latter craft it is almost an everyday occurrence on the other side. A good example occurred only a few days ago.

Imagine, if you can, a gaunt, forbidding-looking shape, rising from the shelter of a dense wood some five miles behind the British lines. The day is clear and sunny. The craft is up directing artillery fire. After some two hours' observation two tiny, dark shapes are observed nearing overhead. Instantly all is consternation. An attempt is made to wind in the kite-balloon. Too late, the enemy planes are now well overhead. They dive steeply, and circle round the craft, dropping bombs, luckily without

registering a hit, at least not on the kite-balloon. The two observers leap out in their parachutes, two tiny black specks that sink like stones to the earth, gradually growing larger as the parachutes open. They land safely. And, at an opportune moment, one of our fighting planes arrives upon the scene, and routs the enemy within only a hundred yards of his target.

But to return to the matter of K.B.'s. I do not think that I am overstating my case by saying that our kite-balloon service is the most efficient and best organized of any of the belligerent nations. For this we have to thank the untiring efforts of Squadron Commander Delacombe, of the R.N.A.S., and, later, Lieut.-Colonel Bovill, R.F.C.

During the last few months, another and more perfect captive balloon has come into use. It was invented by Captain Cacquou, of the French Army. The principal characteristics of the craft are its triple-bag appendage and the increased stability that permits the craft to be flown even in a full gale of wind.

CHAPTER XIII

AIRSHIPS

A COMPARISON between the histories of the lighter-than-air and the heavier-than-air aircraft serves to show us, firstly, that the former is by far the older craft; and secondly, that the principles and construction of the two species are not altogether dissimilar. The natural gifts possessed by the lighter-than-air type would obviously be sooner apparent than the scientifically developed properties of the other craft. And as long since as 1852 a dirigible made a really successful trip in France. This airship was constructed by Henri Gliffard, and made several flights at an average speed of six miles per hour.

Previous to this date, however, experiments had been carried out by the brothers Robert, two Frenchmen, in 1784, in an oblong-shaped craft, 52 feet long and 32 feet in diameter, buoyed up by pure oxygen. A flight of over a kilometre was accomplished in this craft.

The Duc de Chartres made a flight in another of the Roberts' craft. And on this occasion the dirigible encountered a strong cross-current that tore the airbag from the envelope covering the neck and preventing the necessary escape of the hydrogen. Just in time the Duke averted the danger by plunging his sword into and rending asunder the envelope.

The next recorded flight was that made by Dupuy de Lome. And ten years later Tissandier made a flight at an average speed of 10 miles an hour.

In 1872 Hanlein, a German, constructed an airship propelled by a 6 h.p. Lenoir gas-engine that touched a speed of 10 miles. And in 1879 Baumgarten and Wolfert constructed an airship which, unfortunately, was burnt in its first attempt at flight.

But it was not until 1884 that the dirigible developed true airworthiness. In that year Captain Renard flew round Paris at a speed of 14½ miles an hour.

Schwartz, an Austrian engineer, in 1897 built the first rigid airship fitted with a petrol motor. And after this came the period of Santos Dumont, the best known of aeronautical pioneers, and of Count Zeppelin.

These earlier types of dirigibles were, in reality, balloons fitted with mechanical propulsion. Several of the foremost types were driven by hand propulsion, by means of oars. The Zeppelin, or the super-Zeppelin of to-day, and the old-fashioned spherical balloon of the past consisted alike of two similar main portions, the envelope and the car. The envelope was always spherical in shape, and was inflated with hydrogen gas, which is the lightest gas known, being only 7 per cent as heavy as air, of which 1000 cubic feet weighs 50 lb. Thus 1000 cubic feet of hydrogen will give a lift of 74 lb., or practically, 35,000 cubic feet will lift one ton. It must not be forgotten, however, that that " lift " must include the weight of the balloon and gear.

Thus, if a 35,000 cubic feet hydrogen balloon weighs half a ton, it will only lift another half a ton besides its own weight. A modern Zeppelin has a " lift " varying from 20 to 28 tons.

Once in the air, there are many factors that must

be taken into consideration. Chief among them are the natures and properties of the gas, and for that matter of all gases. The effect of heat upon gas is to make it expand, which expansion causes the balloon or airship to rise. *Per contra*, cold causes the gas to contract, and incidentally causes the craft to descend. It will be seen, therefore, that on a fine sunny day the craft will rise with greater ease than when the elements are dull and cold. Air pressure is another factor which must be considered, and this is greatest at sea-level. The greater the altitude the less the pressure becomes, and the less pressure on the outside surface of the envelope the easier it is for the gas to expand; but this is compensated for by the fact that the atmosphere is considerably cooler at a high altitude. Practically these are the only factors governing the science of aerostatics, and we may state briefly that to make a balloon or airship rise it is necessary to allow the gas to expand. This feat is accomplished by throwing ballast overboard in the form of sand; and to make it descend, gas must be dispensed with by allowing it to escape, thus reducing the "lifting" forces.

Airships, of which Zeppelins are the largest and most perfect type, are nothing more than huge balloons, driven in a forward direction by mechanical propulsion. The shape differs materially, being rather like that of a long cigar, but this is by reason of offering less head resistance. Altogether there are three types of airships: the "non-rigid," in which the two portions, the car and the envelope, are entirely separate portions, being held together by means of rigging—most British airships are of this class; "semi-rigid," in which the car is partly attached to the envelope, a type greatly favoured by the French and the Italians; and the "rigid airship," of which both car and envelope are in the

same framework. The Zeppelin is of the latter class.

Now, we discover that the airship is composed of a long wasp-like body, known as the envelope, and containing the hydrogen gas, by which it obtains its lifting forces, and a car or cars.

Lighter-than-air craft were none too popular in this country in former years; but now at last we are beginning to realize their great advantage, and are constructing airships, both large and small, as fast as we are able. Concerning which construction it premises some extremely pleasant surprises for the public in the near future.

As long since as 1900, however, a Dr. Barton constructed an airship with which he made a successful flight over London. Mr. Willows, of Cardiff, experimented up to 1904, and produced the first British craft that was thoroughly airworthy. It was 74 feet in length, 18 feet in diameter, and was fitted with a 7 h.p. Peugot motor. Of the semi-rigid type, it had a single seat and a capacity of 22,000 cubic feet of gas. From Cardiff a flight was made to London, over a distance of 140 miles. Every few miles the pilot, Mr. Willows in person, came down near the ground and inquired his whereabouts by means of a large and powerful megaphone.

It is needless to add that this method of procedure would hardly commend itself to-day, with the apparent hostility of the German peoples.

He accomplished the journey in under ten hours. In November, 1910, he made another flight from Wormwood Scrubs to Douai, in France. The airship passed over the French coast at an altitude of 5500 feet, but in landing in the dark was severely injured.

The Government Balloon Factory at Farnborough was next in the field, in 1907, with a crude

form of craft, constructed with the aid and under the personal supervision of "Colonel" Cody. It was sausage-shaped and named the "Nulli Secundus."

Unhappily it wasn't! And the next craft produced had an envelope of 42 feet diameter. It was fitted with a 100 h.p. engine, and registered a speed of 40 miles per hour. It was named the "Nulli Secundus II." It justified the appellation!

After this craft came the "Baby" in 1910, and the "Beta" in June, 1910. The latter was fitted with a 30 h.p. Gnome engine, made several successful flights over London, and took part in the autumn manœuvres of that year.

In September of the same year the *Morning Post*, as the result of a public subscription, presented the "Lebaudy" airship to the nation. This vessel was in length 337 feet, fitted with two 135 h.p. engines, and flew from Moisson to Aldershot, a distance of 197 miles, in 5 hours and 28 minutes, or at an average speed of 36 m.p.h.

Vickers turned out their first airship on the 24th of the same month, the "Mayfly." She was 510 feet long, 48 feet in diameter, and fitted with two 200 h.p. Wolseley engines. Immediately after leaving her shed for the first trip a gale of wind sprang up and she was totally destroyed.

After the "Mayfly" were the "Gamma," "Delta," and "Eta," neither of which achieved any very great success.

At the beginning of 1914 we possessed only two really reliable airships. They were a Parseval, bought from the German Government, and an "Astra Torres," purchased in France. However, these craft rendered yeoman service in scouring the seas for enemy submarines; thus aiding materially the convoying of the British Expeditionary Force to France.

The Naval Authorities, some time before the war commenced, took over all the lighter-than-air, and are to-day responsible for these craft, which consist for the most part of "Baby's" or "Blimps," or "S.S.'s" and "C.P.'s."

France

Our neighbours across the Channel have made considerably more progress with lighter-than-air vessels than we have ourselves. This is not at all to be wondered at! The psychology of the two peoples is as far apart as the two poles. Where we, in this country, regarded the advent of aircraft in a stolid, unemotional manner, coldly reasoning that if a few hardy adventurers were willing to risk their necks beneath the all-enveloping cloak of sport, that was entirely their affair, but as a practical enterprise it was absurd, and such a thing "wasn't done"; the French, with all the verve and impetuousness of the Latin races, hailed the event as one of the most important and far-reaching events in history, and forthwith devoted the best brains and ample finance to experiment with and develop the airship.

As the pioneer ballooning country of the world, they held a very great advantage from the start. For, as has been already pointed out in this chapter, the balloon and the airship are almost kindred craft.

The Lebaudy Brothers were the pioneers. In 1899 they constructed the "Jaune," a vessel 183 feet long, 30 feet in diameter, and of 80,000 cubic feet capacity. The engine was a 40 h.p. Daimler, and gave a speed of 26 m.p.h. In 1902 she made 29 flights and was successful upon 28 of these occasions in returning to her starting-point. In November of that year she hit a tree when landing and became a total wreck.

In 1904 the Lebaudys produced their next craft, the "Lebaudy." This vessel was possessed of a triple airbag or ballonet, was 190 feet long, and had a capacity of 94,000 cubic feet. She was a most successful ship, and after 76 flights had been made their "rights" were acquired by the French Government, who therewith commenced to construct Lebaudys—they were of the semi-rigid type, with a spar running along the entire length of the envelope, thus evenly distributing the weight—at Moisson.

In 1906 there followed, by the same firm, the "Patrie," and in 1909 the "République." They were larger and improved types of the "Lebaudy" ship, with an average speed of 28 m.p.h., a radius of 280 miles, and accommodation for a crew of nine. In 1907, while the "Patrie" was anchored outside Verdun, she was torn from her moorings in a violent gale, and trailed off over Northern France and the British Isles, and finally disappeared in the direction of the Atlantic Ocean.

The "République," which possessed an engine of some 80 h.p., made successful flights over a period extending from July, 1908, to September, 1909. Then a propeller breaking in mid-air, a blade thereof flew upwards, tore a large gash in the envelope and killed 2 officers and 2 N.C.O.'s. Similar airships of the same type were the "Russie" and "La Liberté."

The first craft of the "Clement-Bayard" type was the "Ville de Paris." In length it was 200 feet, fitted with a 70 h.p. motor, giving a speed of 25 m.p.h. and having a capacity of 120,487 feet. In 1909 came the "Clement-Bayard," a larger ship but built on similar lines. Her engine was 100 h.p. and gave a speed of 30 m.p.h. On August 23rd, 1909, the "Clement-Bayard" flew for two hours at an altitude of 5000 feet, but finished her

career by depositing herself in the Seine. Other ships of this class were :—

The "Ville de Bordeaux" .	3200	cubic	metres.
The "Ville de Nancy" .	3200	,,	,,
The "Colonel Renard" .	4000	,,	,,
The "España" . .	4000	,,	,,
The "Clement Bayard II"	6500	,,	,,
The "Trans-Aerienne I" .	6500	,,	,,
The "Flandre" . .	6500	,,	,,

Several of these latter craft were "Astra-Torres," designed by a Spanish engineer, Señor Torres.

Italy

It has been said by many aeronautical experts that the Italian semi-rigids are the finest in the world. This may or may not be. We are not open to discuss such matters in these few pages, further than to say the Italian Government has always specialized in this type of airship.

The first, the P1—P, "Piccolo," small size—was constructed in 1908. The P1 was 200 feet long, of 40 feet diameter, had a motor of 100 h.p., and possessed a speed of 35 m.p.h. She was not very successful in her trials, and in 1912 the Government purchased a "Parseval" from Germany.

The next home-constructed product was the M Class—M, medium size—with engines of 500 h.p. and a speed of 48 m.p.h. She was 250 feet long and 55 feet in diameter; the largest semi-rigid ever constructed.

The next class, but of the same type, was the Forlanni, and the "Città di Ferrara" was the first ship of the class. She had a capacity of 424,000 feet,

a length of 233 feet, a diameter of 59 feet, and three 85–100 Isotta-Fraschini engines.

The Italian airships have accomplished many remarkably useful flights during the war.

Germany

And by no means least, but last, there is the German Empire. And here again psychology plays no unimportant part. The Teuton is notoriously methodical, invariably a plodder. His inventions are never the outcome of a flash of genius, but generally an idea from some other source, worked and improved upon gradually, painstakingly, until the object of consideration assumes unrecognisable proportions. Germany, then, took a considerably greater time to construct her aircraft, but when finally completed they were perfect in every degree. And she did not, as most people imagine, confine her attentions solely to the Zeppelin.

Among her other accomplishments was the "Parseval," a type of "semi-rigid" airship, the principal feature of which was the arrangement by which the suspension cables allowed the hull to be canted in relation to the angle of the car, in order to enable her to climb at a much increased speed. The first "Parseval" was produced in 1906, but was not a very great success. The second was 190 feet long, 35½ feet in diameter, 113,000 cubic feet capacity, possessed of two 120 h.p. engines, and fitted with the same system of suspension as number one. She made many voyages, with sometimes as many as twelve passengers aboard.

Another type was the wooden "Schutte-Lanz." An attempt by a firm at Mannheim in 1912 to produce a rigid airship constructed of wood braced

with wire. It was cigar-like in shape, and approximately the same size as a Zeppelin. However, the wooden structure rendered her considerably heavier than the latter craft. And no very successful flights were then made, though it is thought that several of the Schutte-Lanz craft have participated with the Zeppelins in raids on this country.

The Zeppelin

The Zeppelin is due to one man, and one man alone. The grey-haired, bent old Count, formerly an officer in the German Army, who lived to find himself, a once much-despised, impoverished inventor, acclaimed the saviour of his country, loaded with honours and riches, the personal friend of the most autocratic of autocracies, and a notorious figure in the history of the world. His iron will and determination triumphed over poverty, adverse circumstance, and disbelief alike, until finally he forced the very people, who had formerly regarded his invention as a waste of time and of money, to clamour in a wailing hell-chorus for that same craft.

Zeppelin commenced his experiments at Friedrichshaven, on the shores of Lake Constance, in 1900. The first ship was 400,000 cubic feet in capacity, possessed two 16 h.p. motors, weighed 9 tons, and carried 5 men. It made only one flight, but during the course of that, remained in the air for one and a quarter hours, and touched an altitude of 1000 feet.

Encouraged by this success, the old man constructed, with the aid of influential friends, in 1906, a second craft. This ship was more powerful than her predecessor, and possessed two 85 h.p. Daimler

engines. A trial flight was made in November of that year, but the craft was wrecked shortly afterwards in a violent gale of wind.

Undeterred by these added misfortunes he persevered, constructing fresh ships as year succeeded year. Until eventually he received royal patronage and the aid of the State; and at the outbreak of hostilities was able to place at the disposal of the authorities some thirty airworthy ships.

Cuxhaven had already been selected as the headquarters of the German Air Fleet, with air harbours at Heligoland, Tondern, Emden, Wilhelmshaven, Hamburg, Kiel, Wismar, Rostock, and Königsberg. These stations had been stipulated for in the four years' building programme of the Reichstag of October 13th, 1913. This programme provided for 10 rigid airships, for several first and second class air harbours, the majority fitted with revolving sheds, and for maintenance of material; the total to be completed by January 1st, 1918.

Of the Zeppelins there were, or rather are, six several types. The which, for purposes of convenience, we will refer to by numbers, from 1 to 6. The first type was the Super-Zeppelin class, that contained products both of the Zeppelin and the Schutte-Lanz ships.

It was constructed at the Zeppelin works, Friedrichshaven, and Mannheim :—

Length . .	630 feet.
Capacity . .	1,906,200 cubic feet.
Useful lift . .	19 tons.
Engines . .	Six 250 h.p. 6-cylinder Maybach.
Maximum speed .	65 m.p.h.
Endurance . .	35 hours.
Maximum altitude	16,500 feet.
Complement .	22.
Armament . .	6 maxim guns.

Class 2 are constructed at Friedrichshaven and Rheinau :—

Length . .	775 feet.
Capacity . .	2,471,000 cubic feet.
Useful lift . .	28 tons.
Engines . .	Seven 250 h.p. Maybach.
Maximum speed .	68 miles.
Endurance . .	40 hours.
Complement .	22.
Maximum altitude	16,500 feet.
Armament . .	6 maxim guns, 4 tons explosives.

Class 3 are constructed at Friedrichshaven and Potsdam :—

Length . . .	528 feet.
Capacity . .	1,059,000 cubic feet.
Useful lift . .	10 tons.
Engines . .	Five 210 h.p. 6-cylinder Maybach.
Maximum speed .	53 m.p.h.
Endurance . .	26 hours.
Complement . .	16.
Maximum altitude .	11,550 feet.
Armament . .	4 maxims, 2 tons bombs.

Class 4 are constructed at Friedrichshaven and Rheinau :—

Length . . .	560 feet.
Capacity . .	1,235,000 cubic feet.
Useful lift . .	13 tons.
Engines . .	6 210 h.p. 6-cylinder Maybach.
Maximum speed .	59 m.p.h.
Endurance . .	30 hours.
Maximum altitude .	13,200 feet.
Complement . .	18.
Armament . .	6 maxims, 2½ tons of bombs.

Class 5 are constructed at Schutte-Lanz factory at Rheinau :—

Length . . .	544 feet.
Capacity . .	1,059,000 cubic feet.

Useful lift . .	14 tons.
Engines . .	4 240 h.p. Mercédès.
Maximum speed .	53 m.p.h.
Endurance . .	26 hours.
Maximum altitude .	8,250 feet.
Complement . .	16.
Armament . .	5 maxims, 1½ tons of bombs.

And lastly, class 6, the latest of all, are constructed at the Zeppelin works at Friedrichshaven :—

Length . . .	521 feet.
Capacity . .	953,000 cubic feet.
Useful lift . .	8 tons.
Engines . .	4 210 h.p. 6-cylinder Maybach.
Maximum speed .	50 m.p.h.
Endurance . .	26 hours.
Maximum altitude .	8,250 feet.
Complement . .	16.
Armament . .	4 maxims, 1½ tons of bombs.

CHAPTER XIV

FIGHTING THE ZEPPELIN

THE novelty of Zeppelin fighting is the main reason for the bitter criticism levelled thereat. It is new, strange, and to a certain degree unexpected. The British public (those that have never been on the other side) have alternately howled, gasped, cheered, and reviled thereat. Because such a thing had never occurred before, because it was a departure from all precedent, it was condemned. The Zeppelin crews were deemed baby-killers and murderers, and one of our own country-women threw wood at the coffin of a dead German airman as it passed her in the street! For this we must thank the foolish, screaming headlines of the daily Press.

But Zeppelin raids are legitimate! I advance this most unpopular view unhesitatingly. War is war, whether fought on land or sea or in the air. The enemy, previous to 1914, gave us a pretty good idea why he was constructing his great Zeppelin fleet, also to what purpose they would be put. It was up to us to take the necessary precautionary measures. What did we do? A Cabinet Minister, with more lung power than veracity, informed us that, should the enemy ever venture to send his aerial fleet over these islands, they would encounter a swarm of defending "Hornets." But the "Hornets" never found their wings.

To these novel circumstances we must immedi-

ately adapt our perspective. No evil is without its remedy, and judging by the excellent performances put up by our anti-aircraft gunners on the occasions of the last few raids—it leads us to believe that that remedy has already been discovered. But, not content with this alone, the best brains in the country must be devoted to this problem of the skies, for the Zeppelin raid is but the pin-prick in the ocean to what the future holds in store.

War in the air has already taken a powerful hold on the public imagination. The spectacular effect has dazzled their eyes, the fascination of the thing has seized upon their senses, and the crudity of their methods of offensive has roused them to the heights of wrath and anger. It will be wise to sweep away these trimmings of romance, novelty, and fascination. Therein is constituted a very grave danger. Treated simply as a vessel of war the Zeppelin is for the time being a failure ; but the age of a Zeppelin as a craft is just over seventeen years. Aircraft have unlimited scope. The future may hold a more powerful Zeppelin, able to climb with ease above the range of the A.A. guns, a combination of Zeppelin and aeroplane, or a heavily armoured form of aircraft, shell-proof against all form of artillery.

The game of the air is like a mammoth game of chess, the opponents sit, unseen and unseeing ; the one somewhere in these islands, the other beneath the mantle of the All-Highest of Potsdam. We move, a new and powerful aeroplane is invented. Immediately after they move, with a yet more powerful craft. The German engineers construct a powerful engine, we go one better. Ours is yet more powerful ! And thus we will go on. But there ! Are not international politics altogether and entirely a gigantic game, a strange jumble of kings, queens, and bishops ?

However, this chapter is primarily intended to be devoted to the matter of defence against raiding aircraft. First it must be well realized that it would be a matter of utter impossibility to guard each and every townlet and hamlet from attack from above. Such a course would require a multitudinous number of guns, searchlights, men and craft alike, and particularly to-day they cannot be spared. It will only be possible to guard the more important positions. And in the meantime it will be a comparatively easy matter for the pilots of the raiding craft to pick out the least defended districts by a simple study of the map.

How are these raiding Zeppelins to be met? Obviously the best method is with similar craft. With Zeppelins of our own, the best defensive policy would be to take the offensive. To raid and bomb the enemy craft in their sheds and air harbours would indeed be carrying the war into the enemy's country, as they have carried it into ours. And it would serve the further purpose of preventing any possible raid. As an alternative, our craft could scout over the North Sea somewhere off the German coast and either give them battle at their weakest moment—i.e. with a heavy load of bombs and spare petrol aboard—or give ample warning by wireless to our fleet and home defences.

As our Zeppelins have not yet materialized (?) we must consider our present possible methods of defence, and they consist principally of anti-aircraft guns and aeroplanes. With these it would surely be reasonable to establish, somewhere along the east coast, a definite line of defence; or rather shall we call it an air-board similar to the sea-board supplied by the North Sea? Here concentrate all our aerial defences!

Of them all, the anti-aircraft gun is most effective,

but even that is useless without a good searchlight. Neither is dispensable to the other. The *modus operandi* is for the distant listening post to give warning of the approach of the Zepp, as will also the incessant barkings, or rather whimperings, of the dogs of the neighbourhood over which the Zepp may happen to be. The searchlight will then first locate the craft, and following it incessantly with the light, put it within easy view of the gunner. The gunner, having the craft in view, proceeds to find the range as follows :—

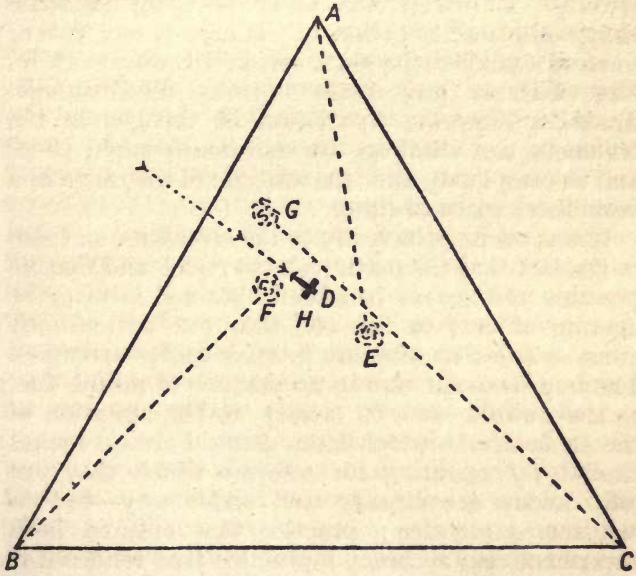


FIG. 7. TRIANGULAR METHOD OF OBTAINING RANGE AND ALTITUDE OF HOSTILE AIRCRAFT

Thus far we have confined our attention to stationary guns alone. Many of the A.A. guns, and practically all those of the enemy, are mobile—that

is to say, they are mounted either on motor-lorries or on railway trucks. Being able to move the guns quickly from place to place makes the matter of range-finding and accurate firing easier and less complicated for the gunners. But the Zeppelin, despite its great bulk, is a most elusive target.

In the first place, we will suppose that the shell has burst on or in close proximity to the aircraft. Had the envelope been in one single piece, as was the case in former days, the craft would crash down to earth immediately. Nowadays, however, the envelope is merely the outer covering to some thirty odd smaller ballonets. If only one or two of these are pierced the craft can still continue on its way without any really serious disadvantage. Again, a Zeppelin, by reason of the gas in the ballonets, can climb at an enormously rapid pace, and so completely alter the altitude of the range in a very short space of time.

It was owing principally to these reasons, and also to the fact that the matter was so novel, and that no practice whatsoever had been obtained in firing at moving objects in the air, that our anti-aircraft gunners failed so dismally in their earlier attempts. The improvement was in no manner of means due, as they would have us believe, to the agitation of the *Daily Mail*—which latter journal always makes capital by agitating for reforms which they are fully aware are already well under way—but to continuous practice; practice that ensured both experience and accuracy; practice that rendered it possible for them to bring down the Zeppelins at Cuffley and Potter's Bar.

For without good gunnery it would be impossible, save in exceptional circumstances, for an aeroplane to bring down a Zepp unaided. The latter are the matadors of the air, which, after the Zepps have

been crippled or disabled, perform the necessary finishing strokes. Which brings us to the third means of defence, namely, the aeroplane.

The discussion between the relative values of the airship and aeroplane is the most difficult and delicate matter connected with aviation. The aviation world has always been, and will always be, divided into two camps, the one that swears by the lighter-than-air, the other by the heavier-than-air craft.

A comparison between the two craft serves to show us that "lift" is the main property that most stringently divides the merits and the demerits of the two. The weight of the aeroplane body, wings, engine, fittings, etc., takes up at least 50 per cent of the total "lift." The weight of the pilot, observer and accessories takes up another 25 per cent, which allows only twenty-five for "war lift," by which I mean that necessary for bombs, ammunition, machine-gun, and spare petrol. The Zeppelin, on the other hand, has two sources of "lift," namely, the natural "lift" of the envelope and the "lift" supplied by the motive power, and almost double the "lift" in aggregate.

And "lift" effects speed in climbing, also allows for greater engine power aboard. Climbing is essential, for the aerial combat is always fought out in the upward direction, and the best strategic position is to be well over the enemy craft. Also greater "lift" allows more space aboard for supplies of bombs, ammunition, and spare petrol. Therefore in the all-important matter of "lift" the Zeppelin has a distinct advantage.

The aeroplane, however, has a distinct advantage over the Zeppelin in the matter of speed in a lateral direction. But the latter is becoming faster every day. The aeroplane, again, is essentially a craft of

the daylight. The danger of landing the heavier-than-air machine, always a tricky operation, is trebled in the darkness of the night. The supply of petrol aboard is extremely limited, and the duration power at the outside is six hours. That of the Zeppelin is somewhere in the neighbourhood of twenty-six.

In the darkness, and even in daylight, the aeroplane pilot rarely sights a Zeppelin, the meeting being entirely a matter of luck and circumstance. The Zeppelin pilot can shut off his engines, and by ballasting can proceed unimpeded at his original altitude—which the aeroplane can never do—and be able to listen for the approach of the aeroplane by the sound of the engine, and manœuvre accordingly.

The aeroplane can only bring a Zeppelin down once it has climbed above it; and it must be admitted that in that position the latter craft is entirely at its mercy. Several of the Zeppelins have a machine-gun mounted on top of the envelope, but this weapon is little better than useless against bombs. Again, however, for the aeroplane pilot the danger arises; in bombing he may miss the enemy craft, and the bomb drop down to the land below. Should engine-failure occur while in mid-air the aeroplane must come down immediately, but the Zepp can continue on its way.

Although the altitude record of the aeroplane is considerably higher than that of the Zeppelin, the average flying level is considerably less; being with the former some 12,000 feet, with the latter some 16,000.

The aeroplane, as a craft, is comparatively inexpensive to construct, the landing-ground required not extremely extensive; neither the personnel to maintain the craft on the ground. The

aeroplane hangar is no mammoth erection. The Zeppelin, on the other hand, is extremely expensive to construct. The personnel aboard require at least twelve months' preliminary training. The landing-ground required is enormous, likewise the personnel to house the craft, also the shed to contain it.

The Zeppelin is much more the victim of adverse climatic conditions and thus less airworthy. There have been considerably more craft lost that way than by casualties.

Finally, it must be an extremely fast aeroplane with great climbing powers to successfully tackle a Zeppelin in mid-air; and, again, the aeroplane must be well up before the Zeppelin arrives overhead. The Zeppelins, it is known, have on several occasions been convoyed by powerful-engined aeroplanes; and this fact leads me to observe immediately the similarity between this manœuvre and that of the large type of warship convoyed by a skirt of torpedo-boats at sea.

Entering upon the actual combat, the Zeppelin is more heavily armed, and the steadiness of its gun-platform allows it a great advantage in the matter of accuracy of firing. It is, however, when compared with the aeroplane, a slow and clumsy craft to manipulate. It is preferable for two or three aeroplanes to attack a Zepp at one and the same time, as was recently the case off Norfolk.

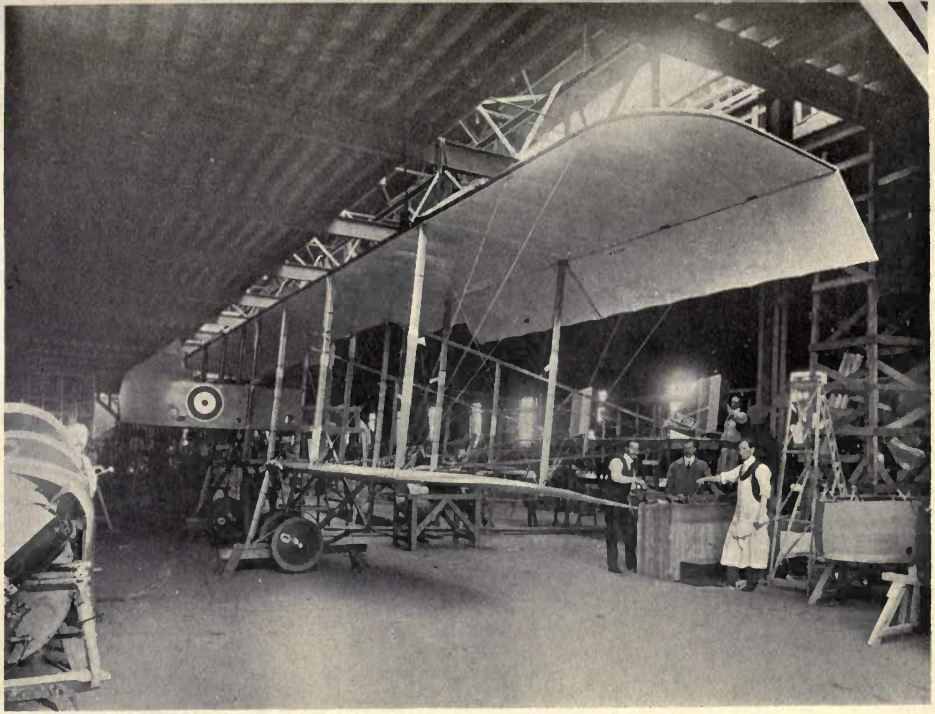
An American paper said recently, with reference to our latest anti-Zepp aeroplanes:—

"In spite of the tendency to exaggeration in the reports of the new war material which is being developed in Europe, it is possible to sift out the true from the false, and there is good reason to believe that the British, in their latest aeroplanes, have found an effective answer to the Zeppelin.

"When the first raids on London were made,

the British possessed neither the guns nor the aircraft in sufficient numbers or quality to meet, destroy, or drive back the latest Zeppelins. The anti-aircraft guns could not reach effectively the great heights to which the Zeppelin could rise, nor could the aircraft rise in time to attack. Since that time both guns and aircraft have become thoroughly efficient for the work. Just in what numbers and of what calibre are the anti-aircraft batteries with which London is now so well defended, is not known; but, because of the great value of high velocity and a straight trajectory for anti-aircraft gunfire, it is a pretty safe guess that there are many batteries of guns larger than the 3-inch. The 50-calibre 4·7- and 6-inch gun, if fired at high angles of elevation, have a trajectory of slight curvature and the time of flight is small, elements which simplify the task of the gunner in finding and keeping on a moving target.

"Information is now available as to the new anti-Zepp aeroplanes, and Lieut. —— of the Royal Flying Corps, who recently landed in New York on furlough, has given some details which agree with information we have received from another source. The problem has been to build an aeroplane with climbing powers sufficient to enable it to reach Zeppelin altitudes in time to meet the raiders and bring them down. The latest machines are of comparatively small wing surface, and are driven by unusually powerful engines, capable of making speeds of 120 to 140 miles per hour. The increase in climbing speed in the past few months has been truly astonishing, having progressed from an ascent of 10,000 feet in 6 minutes to 15,000 feet in 7½ minutes. The scouting service, both on the North Sea and along the east coast, is now so effective that London is warned of the approach of the



A "PUSHER" BIPLANE WITH PROPELLER TO THE REAR

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Zeppelins in time to permit the Zeppelin chasers to take the air and be in position for an attack before the raiders reach their objective."

An invention which promises a decided usefulness in this matter is a 3-inch aeroplane gun, that hurls a shell at a velocity of 1000 feet a second, but has no recoil. *Popular Mechanics* describes it as :—

"Designed particularly as offensive armament for aeroplanes, a high-power 3-inch gun of the quick-fire type has been developed which does not recoil when discharged. This distinctively new feature enables the instrument to be installed on a light machine of almost any size and fired freely without danger of shattering or capsizing the craft. The piece is unlike all other guns, and is apparently suited solely for aerial purposes. Its bore is uniform throughout and has no surface upon which pressure can act longitudinally. The barrel, instead of being open only at the muzzle, is open at both ends. This permits the propulsion charge to act in two directions, thus obviating the recoil. The projectile is hurled from the muzzle toward its target at the same instant that a quantity of metal filings or fine shot is discharged from the breech. After travelling a short distance the latter loses its velocity, so that it cannot injure soldiers below at the rear, although it closely resembles that ordinarily used in pieces of the same calibre ; the ammunition is specially made for the gun. The projectile travels at a speed of about 1000 feet per second. Light process steel reduces the weight of the gun to the minimum."

Finally, and from what is considered a wholly dependable source, information comes concerning a most unusual aeronautical experiment being carried out by German aerial experts. It deals with the development of a powerful flying boat which carries, for both defensive and offensive

purposes, a swift, mosquito-like aeroplane on its back. The idea is almost analogous to the Dreadnought and destroyer of naval use. The machine, when last heard of, was being put through test flights, but had not at that time been sufficiently refined to warrant its actual use.

The new machine has such remarkable stability, carrying capacity, and cruising radius that its engineers think it can be made to replace the more bulky and highly-expensive Zeppelins. If this actually comes to pass it will mark the recognized triumph of the heavier-than-air machine over the much lauded dirigible, for war purposes at least.

It is a heavily built triplane mounting three motors. The wings, which are staunchly built and of a design that gives the craft great inherent stability, have a total spread of approximately 146 feet. The body is entirely enclosed and its windows fitted with reinforced glass that will not fall apart when subjected to heavy impacts. The panes are made by gluing two thin pieces of glass to the opposite surfaces of a heavy sheet of transparent celluloid. When struck with a hammer, for instance, the shattered part of the glass remains fast to its backing.

Although it is to be supposed that a craft of this size would be difficult to manœuvre, as compared with the lighter and more agile machines, it is said to have unusual qualities of stability, because of its design, and to be capable of battling successfully against heavy, fickle air currents that would swamp most flying boats. It mounts two quick-fire guns of small calibre, carries a crew of five men, a cargo of half a ton of bombs, and a sufficient supply of fuel and oil to keep it in the air for forty-eight hours.

The auxiliary aeroplane which it supports on its back is equipped with bomb-dropping devices and

a machine-gun. It is provided in order to ward off the attacks of enemy craft and to drop low and hurl high-explosive projectiles upon particular objects of attack, such as arsenals, forts, docks, and naval vessels. The chief difficulty standing in the way of its perfection has been the problem of providing some practical means of enabling the small craft to return to the mother machine after executing its mission. No trouble has been encountered in carrying the tiny machine, nor in launching it in mid-air, but it has been found quite another thing to pick it up again. And this is necessary to render the unit efficient for the part it is intended to play.

CHAPTER XV

THE AIRMAN'S POINT OF VIEW

THERE was a look about him that was distinctly of the air; good, clear-cut features, hair that tended to curl, a thick-set figure, supple and muscular. But about the eyes one noticed particularly a not unpleasing steely look; a slight contraction about the temples. The indefinable expression of the man to whom danger is fraught with full meaning but small fear.

"I can't understand it," he said, "this feeling that our work in the air is so daring and so heroic. What about the poor devils in the trenches? Personally, and for that matter, almost every airman I know entertains a wholesome dread of paddling about waist-deep in a muddy trench. And, strange to say, the infantryman reciprocates the feeling—the admiration, I mean. I met a man only the other day: 'You beggars must have nerve,' he said. 'I couldn't do it myself.' Why not?"

"Perhaps it is because flying is so novel; so little understood," I suggested.

"Bah! There's not the least thing unusual about it. It's a much more prosaic and matter-of-fact business than submarining, for instance. There's a cold-blooded calling if you like. That's the man for my hero. Besides, you never hear anything said about the man who creeps out of a trench in the dead of night, under heavy shell fire all the time, to bomb an enemy dug-out, or the man who dashes across

No Man's Land in a tank, or a sailor who's patrolling the lonely seas through every vile wind that blows."

"But the air——"

"Ah, yes, the first trip, it shakes you up a bit, I admit, but you soon get accustomed to it. You rock about when you get into the bumps—cross-currents of air—and feel that you want to grasp the sides of the machine for mental support. Then when she starts coming down, and the nose of the aeroplane sinks down in front of you, you feel your stomach edging up towards your mouth, but that is all. Afterwards it's just a matter of experience and plain common-sense.

"Then? Oh, then you just knock around getting the hang of things, as it were, learning how to take down and build up an engine, to box a compass and set a course, and to operate your wireless and machine-gun. Several passenger trips in an aeroplane follow on. That's to accustom one to the new sensation. After that you go up for a few flights in a dual-control machine, to acquire the correct movements of the rudder-bar which you operate with your feet, and the joy-stick that manœuvres the craft up and down, to the left and to the right.

"About that period you're what's known as a 'Hun.' Oh! just a youth who's learning to fly, you know. We've got a quaint slang, peculiarly our own conception. A 'bus' now is an aeroplane. A 'stunt' doing some unusual trick in the air. A 'bump' you know already. 'Getting the wind up you,' a not very picturesque way of saying that a fellow is feeling extremely nervous. And a 'gas-bag' is one of those ugly brutes they use for observation, that sit like diseased and fallen angels in mid-air. By the way, the Naval Air Service vary 'Hun' with 'Quirk,' and they've got a pet name for every stranger they meet—'George' I think it is.

"No; getting your aeroplane ticket's not a very difficult matter—a distance flight of about 547 yards, turning round two posts, once to the left and once to the right, a landing without your engine, and a landing made on a given mark. But in the R.F.C. that is only half the battle won. You've still got a lot to learn before you get your wings.

"Practically, you may say then the new hand is taught to regard the air as a bad master but an obedient servant. It must never be feared, always humoured, and never taken liberties with. Every movement up there must be gentle, not sudden, and never violent. For the craft is one of moods. For in this the aeroplane is akin to a child, now sulky and petulant, now happy and obedient, now unruly and violent. To know these humours and to master them is all part of the pilot's education."

I asked, "What are the feelings experienced on the first trip across the firing-lines?"

"Feelings!" he replied. "They are a strange mixture of pride and fear, a certain feeling of satisfaction in something achieved, something done—a nervousness bordering on curiosity with regard to any unusual happening that may occur.

"Below, the earth is very similar in appearance to what it is at home—a jumbled medley of green and blue and grey. Here and there are little white puffs of smoke that spring up suddenly and die away again in the same mysterious fashion. It is by the time you are over the trenches that your real business as an airman commences. Before, it has been merely a matter of 'joy-rides' over peaceful meadows and rivers and fields. Here you realize that you have the greatest battle in history beneath you, and somehow you feel that you are only a spectator.

"Though," he added hastily, "they say that the

onlooker sees most of the game. This is certainly the case in the air. It is like watching two eager opponents making their moves in a gigantic game of chess. At last you reach the trenches, looking like two great cracks that run zigzag fashion across the surface of the earth. They open fire with their anti-aircraft guns. An unpleasant moment. Shrapnel's never very pleasant, but high explosive, ugh !—that's beyond words. Then, of course, it's all a matter of luck. Some fellows get through all right, again and again, others get pipped the very first time across. And you finish your reconnaissance, or your bomb raid, or whatever it is, and go home again," he finished naively.

" Fighting ? "

" Well, the first fight in particular."

He pondered hard for a few seconds. " Well," he said, " you'll have to use your imagination a bit."

I smiled acquiescence.

" You are," he continued, " 8000 feet up on a clear summer's morning.

" Northwards to the sea, southwards to where the earth is lost in the mist and cloud, stretches the grim battle area. Down below the roads are thronged with traffic—motor transports, gun-limbers, supply columns, a regiment on the march, a battery of artillery. A little group of white-roofed huts indicates a field hospital ; behind the woods groups of old-fashioned bell-tents mark an infantry rest camp.

" As we climb higher the view extends, now taking in the misty English coast-line and then the occasional flash and smoke-burst of a big gun somewhere in front. A kite-balloon, unearthed from a sheltered declivity, rises ponderous and ugly from the ground. Aeroplanes seem to come creeping up from all quarters. Every moment we are climbing higher

and drawing nearer to the battle area. Now the winding lines of trench are visible, the smoke clouds of the big guns. The enemy is putting some 'heavy stuff' into the little town immediately below, which commands two main roads and a railway junction. We get our first dose of 'Archies,' but are far out of range.

"Who can describe one's true feelings in that first flight across the lines? Fear and bravado, nervousness, desperation, hope and despair, all are experienced. Before the next 'dose' we climb higher; the latter may have been a chance shot, but the next attention, when they have us under observation and have gauged the range, will be more methodical.

"Now the earth is Lilliputian—a toy world, where men crawl like ants, and there are tiny pinpricks that deal out death and destruction. Whole armies are crowded into spaces that appear to be only a few square yards. Can this be the greatest war in history, this pigmy affair, this scattered collection of darkish shapes, units of the two greatest armies in Christendom? Convincing proof is not long in coming; two shrapnel shells burst in unpleasant proximity, and high explosive jolts and jars the machine in nerve-racking fashion.

"Down below the most prominent landmarks are the trenches—winding, turning lines of grey and white, serried across the deep grey surface of the earth. It is a curious phenomenon this—that when the surface of the earth has been disturbed in any way it should always show up so prominently from above.

"Over the lines and well into the enemy country, we are not long in finding our objective. From behind a bank of cloud a great Albatross appears coming 'down wind' at a rapid pace. Now for it!

"An analysis of one's feelings would shatter every recognized theory of psychology. First, one measures the opponent with his eye and gauges, always incorrectly, his capabilities. What is his speed? Is he higher or lower in altitude? A mad joy, a wild impetuosity seizes the pilot. He wants to get at close grips, but that is impossible in the air, and there is something unsatisfying, something disappointing in 'potting' at a man from a distance, wheeling by him at sixty miles an hour without even a glimpse of his face. What is he thinking of? What will he do?

"Then there comes a feverish anxiety to know whether the observer is ready. Why is he fumbling with the Lewis gun like that? Can't he fix the tray? At last all is ready. He turns with a smile.

"Still half a mile away, the enemy appears to be slightly above us. We open out the engine and climb as fast as we can. Now we are level with him, but a quarter of a mile to the right. A few passing shots and he has flashed by. We wheel back and turn slightly inwards, very close this time. The machine-gun at his nose spits red, and ours replies; the fight resolves itself into a machine-gun duel between the observers.

"A few bullets flash past the wings, one ripping the fabric, but no harm is done. Again we wheel, again plunge into the fight, again engage in the machine-gun duel. The foe is wheeling and climbing until he gets above us, and our danger is very real when his observer turns his machine-gun on us. It is a tense moment, for a few seconds will decide whether we live or die, return home again in comfort or go spinning down broken and uncontrollable to a hideous death beneath.

. . . . . .

"The observer has been hit in the arm and the blood shows through his thick tan coat. Must we give in and go? No; the observer is a plucky chap and, tying up the wound as best he can, he signals smilingly to go on. We climb gradually until at last we are rising above the enemy, and ours is proving the more powerful machine.

"At last the moment arrives when we almost hover over him. Zipp-zipp-zipp, goes the machine-gun. He staggers, recovers himself, staggers again, and then begins to climb rapidly. It is his last chance to live. We 'open out' as fast as we can and follow him, the machine-gun yapping in the prow. Earth and sky, danger and safety, everything is forgotten in this mad rush through the air, with the wind whistling by, and our ears deadened by the roar of the racing engine. All that is most primitive, most savage, rises in a man's breast at a moment like this. The only desire is to kill, kill, kill.

"Now the enemy is struggling on as only a man can when it is a matter of life or death. Now! But the machine-gun tray has run out. Another tray! Quick, or we shall miss him. . . . Just in time! The other staggers. His machine begins to plunge and lurch, then suddenly it noses down, and falls with a sickening speed towards the earth.

"The glow of victory, the feeling that cannot be equalled in this world, seizes one—but with it a feeling of genuine sorrow for an opponent who has fought like a sportsman and a man.

"So, you see, it's all really so matter of fact and commonplace. There's nothing that savours of heroism, nothing at all," he concluded naively.

CHAPTER XVI

HOW A BATTLE LOOKS FROM THE AIR

"IMAGINE," he said—and he was an authority upon such matters—"imagine a sweeping, animated vista of land and sea, valley and hill, city and meadow. The world at your feet! A landscape limited alone by distance and oblivion. Imagine, again, that you are gazing into one of those strange contraptions that house themselves on piers and promenades of popular seaside resorts, in which may be seen for the humble sum of one penny a varied panorama of the world, and you have the airman's outlook. Well, perhaps, not quite!

"We, that is to say, my observer and myself—nowadays it is becoming more and more the unpleasant duty of the pilot, like an aerial chauffeur, to merely fly the machine, while the observer directs the course and laps up the brainwork—had received orders to proceed forthwith over X—— to direct artillery bombardment, preparatory to an infantry advance on a large scale.

"The day was well advanced, moderately clear with milky thin racing clouds that hung low. These we skirted after the manner of a steamer hugging a friendly coast-line. Our orders were positive; direction of artillery fire, fighting disallowed.

"Yes! That is a hard-and-fast rule. Fighting for the likes of battleplanes. Reconnaissance for special craft told off. The latter never to enter combat unless defensive."

"The various types different in character?" I ventured mildly.

"Mostly as regard engine-power," he replied briefly. "For reconnaissance an engine with duration; for fighting—speed and climbing-powers.

. . . . . .

"Prominent below, a long, straight high-road, tree-lined on either side, pointing with the directness of a signpost to the firing-line. We are low enough to distinguish the crawling streams of traffic in either direction. From the level of the ground this road appears packed to extremis. From above, at the same hour, large patches of white road surface can be seen between—a heavy gun, drawn by a smoking 'Puffing Billy' on a limber; a string of supply lorries returning from their bi-diurnal trip to the trenches; a company, or is it a battalion, of infantry toiling linewards to relieve; motor-buses, motor-bikes, ambulances, farm-wagons, and motor-cars.

"Only from above can one gauge the vastness, the complication of this world campaign. On the fore-front of the stage, well in the limelight, the marionettes, the gallant infantry who hold the trenches. They are worked and moved back and fro by the orderly jumble of live wires that reach to a back-distance apex, some fifteen miles. The base is C.H.Q., from whence, in triangular formation, the wires extend to divisional H.Q., thence to brigade, thence to battalion, immediately in rear of the scene of action.

"And the motive power that supplies the current to work the marionette, the plain word of command.

"For the rest, a three-belted panorama of earth surface, the green, fresh look of the peaceful country-side; the green, tinged with brown, of the

districts adjoining to the mud-brown waste, from which rise, here and there, a column of smoke which needs no definition. Standing back from the high-road a frowning château, timbered around, with a large sheet of blue water before. Slightly incongruous, it strikes one, in such surroundings. But apparently it has its uses. Aside of it there rears itself a gaunt and ugly wireless pole, a fringe of white-domed bell tents, a fairly continuous crawl of motor traffic, up and down the broad drive; evidently an H.Q. of some description.

"On again, over a town of ample proportions, evidently convalescing after a severe bout of bombardment. The scene of action draws near. Now we have to discover our own particular sector for observation.

"Oh, yes! By map, marked out preliminary to leaving the ground.

"Now we are over shell-fire. The observer is busy wirelessing to the guns. The continuous series of white-grey bursts reveal the results of their fell business. But we hear nothing! Only the continuous grunt of that infernal engine. It is an eerie, blood-chilling sensation, to know that down there, somewhere below, the air is rent with the shriek and whine of the great shells in their transit, and the roars of the resulting bursts.

. . . . . .

"It is getting near the time now for the signal to advance. Seven o'clock was the hour decided.

"At ten to, the white shell-bursts cease and fade away. By rights we should be turning for home now. But this is the finest spectacle of all. The anti-aircraft bombardment has long since ceased, for a most excellent reason, the guns are *non est*. We can sink to a lower altitude with perfect safety.

"Eight minutes to seven! Six! Four! Will it never come? At last! Even in the air, thousands of feet above, we get the atmosphere, the second of hesitation, the quiet before the storm. Then the dull waste of No Man's Land is alive with moving ant-like figures, that appear, almost miraculously in swarms, from those hidden ruts in the surface of the earth.

"Now a similar body makes itself manifest from the opposing trenches. The two lines meet. They intermingle into a bewildering jumble. For one brief moment the line is taut and rigid. Then it wavers, solidifies, wavers again, and breaks. But which is it? The line farthest from our own trenches!

"It lasts for but ten minutes. Above it seems a lifetime. We turn for home leaving behind a charred and burning earth, from which the smoke and dust rise in mournful and never-ending clouds."

CHAPTER XVII

AIRFARE OF THE FUTURE

WE are at last beginning to realize that in aircraft we have a hitherto uncontrolled factor of war that will alter entirely every condition of the modern civilized world.

No one dare predict exactly what the future holds in store for aviation: but it may safely be deduced that warfare will be to all purposes instantaneous. The belligerent fleets of aircraft will set out with the dawn or darkness as the case may be, and within twelve hours the conflict must be finished one way or the other. For the airman there is no falling back on a reserve line of trenches, no preliminary skirmishing and no quarter: the fight must be to a definite finish.

But war is only one side of the matter. On the one hand we have the use of air machines as craft of war. On the other, the numerous uses to which aircraft can be put as vessels of commerce. Which will be considered the more important—to develop aircraft for war or for commerce?

The answer is obvious. We must have air vessels for both purposes. And the latter is by far the more important. We may not think so to-day amid the turmoil and anxiety of war, when our thoughts are all alike, devoted to the same purpose: but the fact remains. The war has revolutionized the social status of the world. In the near future, when socialism and the labour movement have further

developed, war will be non-existent. This war, provided that democracy gains the upper hand, will be the last. But human nature is human nature, and there will always remain the turbulent spirits in our midst, and to keep these people in order it will be necessary to display a certain amount of armed force.

However, aircraft, and particularly the airship, of all the weapons employed in warfare, will prove itself to be the only one that will serve a satisfactory purpose after peace has been declared.

Of what use are the 15-inch shell or the trench mortar, or the torpedo or the ·75 to humanity when war is finished? But the services of aircraft in the future will be inestimable. Likewise the Zeppelin has been considerably developed, but will serve a somewhat different purpose.

As there have been entirely different types of sea vessels for war and commerce in the past, so in the future there will be widely differing classes of aircraft. For a craft of war, every unnecessary frill is stripped away. She enters the combat, like a battleship, with her decks cleared; every available inch of space being required for powerful engines, and spare petrol to give her the necessary high turn of speed and climbing power. The altitude at which she flies must be well over twelve thousand feet. And great powers of duration are unnecessary. On the other hand, the commercial aircraft will need greater powers of duration, a greater "lift," more space aboard, less speed to climb, and an altitude of between five and six thousand feet will be all that will be necessary.

It is practically impossible to construct an aeroplane possessing speed, duration and climbing powers alike. For the former, as also the latter, a highly powerful engine is required. This requires

and minerals will follow the old-fashioned route of the sea and the railway.

The principal aerial trade routes will, most probably, be two main tracks leading south and two main tracks leading east. The first southern track will follow the route : London-Paris-Bordeaux-Gibraltar-Fez-Lagos-Loango-Johannesburg-Capetown. Allowing a minimum average of 110 miles per hour, with little wind, and allowing half an hour for each landing, an aeroplane leaving London at eight on a Monday morning would keep the following time-table :—

London . .	8 a.m.	Monday.
Paris . .	10 a.m.	,,
Bordeaux . .	1 p.m.	,,
Gibraltar . .	8 p.m.	,,
Fez . . .	9 p.m.	,,
Lagos . .	5.30 p.m.	Tuesday.
Loango . .	2 a.m.	Wednesday.
Johannesburg .	8 p.m.	,,
Capetown . .	4 a.m.	Thursday.

Total : London-Capetown, 2 days 20 hours.

By steamer, *via* Funchal, the time taken is three weeks, which gives an advantage of two and a half weeks. Another route to Capetown would be: London-Paris-Lyons-Rome-Alexandria-Ankobar-Mombasa-Zanzibar-Bulawayo-Johannesburg-Capetown.

The "Far East" routes would be: London-Petrograd-Moscow-Samara-Omsk-Tomsk-Irkutsk-Pekin-Tokio, and London-Berlin-Warsaw-Odessa-Astrakhan-Merv-Delhi-Calcutta-Canton-Shanghai-Yokohama-Tokio. The Australian route would follow the latter as far as Calcutta, and branch off there, *via* Singapore-Surabaya-Port Darwin and Adelaide to Melbourne.

A CORNER OF THE WHITEHEAD AIRCRAFT CO.'S AERODROME

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Finally, we have been introduced to the aeroplane and the airship in all their numerous spheres of activity. The Zeppelin we have discussed at great length, the Parseval, the Schutte-Lanz, the triplane, and the "Baby" monoplane. We have dabbled with the past, in the early days of aviation. We have lingered with the present, and timidly peeped into the future. We stand now like a swimmer on the fringe of the great ocean, hesitating to plunge into a sea of uncertainty, that may hold for us only the calmest of pleasures, or on the other hand, the most gruesome of dangers.

As I write, the news of a great air battle is to hand. "Germans lose 46 machines, British lose 28 machines. Intensest fighting between large squadrons of aeroplanes." It is the writing on the wall—the herald of the gigantic matters that are to come; when the aerial navies will be maintaining peace and goodwill not on, but over the surface of the earth.

The handling and ordering of these multitudinous craft will be no small matter. Every reader who has sailed down Channel in the piping times of peace has some idea of the ever dangerously congested state of that waterway. That will be as nothing when compared with the numerous craft that will throng the aerial routes both south and east. Aircraft, we know, when meeting under way, must pass each other always to the right, and at a distance of over 100 metres. This indicates, then, that the rule of the air, as of the road, will be to the right. The traffic will be divided into two continuous streams by floating aerial lightships that will serve the double purpose of landmarks by day and lightships by night. There will be two tracks, the one above the other, the higher for lighter-than-air, the lower for heavier-than-air craft.

The matter of entering the territorial limits of a country has already been allowed for in the Aerial Navigation Act of 1913, which prohibits certain areas to foreign craft, also the carrying of goods chargeable upon importation into the United Kingdom with any duty of customs. It will be practically impossible to make the necessary examination of incoming craft in mid-air. And it is possible that a large open space as Salisbury Plain will be utilised for this purpose ; with Government boats always patrolling on the look-out for suspicious craft and smugglers. The other regulations will be similar to those of the present day applying to merchant vessels.

The actual flying conditions will be far less dangerous, more airworthy, and considerably more pleasant and healthy than those appertaining to sea voyages. The aerial voyage will be a God-send to those passengers liable to *mal de mer.* The spherical world will be enlarged from the level of the sea and the land to that of mid-air.

It will be interesting to note how a developed and general aviation will influence our everyday life. For some eight hundred years, until the advent of the Zeppelin raids, the British race had been immune from enemy attacks. It was always possible to escape the ravages of enemy ships and guns, by the simple expedient of living without their range. But is it possible to find a spot without the range of aircraft ? Does this mean that for the sake of peace and comfort we will perforce resort to the methods of the prehistoric tribes, and develop again into a race of cave-dwellers ?

With houses burrowed into the sides of the hills, or in underground cavities, far beneath the surface of the earth, is safety alone possible. With the advent of the " Zeppelin cellar " one may almost

imagine the leading theatres, museums, and restaurants, and the places of amusement, on a level with and leading off from the underground railways. A long line of dwelling-houses along either side of the lines, and an extensive system of underground ways, distancing from as far as London to Manchester, Glasgow to London or Plymouth. Who can say? The idea is of the farcical-humorous order judged from the standpoints of to-day. But then, so was the aeroplane and the airship to the peoples of the early nineteenth century period; the submarine and the oil-fueled battleship to their sons and grandsons of the later half of the century; and the tank and the gas-shell to the majority of our own generation as late as 1914.

A flight in the air, once a matter of world event, is to-day a matter of the uninteresting commonplace. In the future it will be even more so. Even the most timorous of women will take to it, with the ease that they took to sea-voyaging in the past. For flying is no longer dangerous! The price has been paid, and dearly paid. The very novelty of aviation served to furnish fifty per cent of the assumed dangers. That novelty has passed away entirely and for good.

Where a man in former days employed a motor-car as means of personal transit, he will, in the future, make use of an aeroplane. The landing in London will be accomplished on wide, flat roofs. And aeroplanes constructed on the ornithoptic principle will be able to effect a landing in a confined space about the area of Leicester Square.

In time, probably, the unpleasing roar of the engine will be silenced, or at least diminished. The steadiness of the flying will be greatly increased. And the lines and construction of the machine will follow the principles employed in the construction

of the ocean-going liners of to-day. By means of improved wireless telegraphic and telephonic systems, constant communication will be maintained with the earth from any altitude and from any distance.

Aircraft will prove of immense value in exploration. No corner of the earth, however hidden away, will be inaccessible from above. Supervision and police patrolling of out-of-the-way districts will be aided materially, and a certain amount of surveying will be possible from the air.

The psychology of the peoples will play no small part in the future development of aviation, as also in the future mastery of the air. And it has been demonstrated in a previous chapter that our own race in this respect shows more than usual promise. As it was the race of soldiers who dominated the world in the early days of continents alone, and later after the discovery of America and the more general usage of the seas the race of sailors, so in the future it will be the race of airmen that will dominate the world.

But each and every nation is made up of types of manhood. There is the "land-lubber"; the self-centred individual; the materialist with never a thought beyond his own profit and loss; the frontiersman, or the colonist, the greatest patriot of all, who gives his life unasking, and unthoughtful of reward, on some out-of-the-way frontier, manfully pushing on the development of civilization. There are the men from the hills, hardy and independent, seeking advancement by labour and strength alone, and the sleeker men of the plains, who substitute cunning for labour.

Previous to 1914, we people of Great Britain were notorious for our egotism and overbearing arrogance. How many are there even of our great

men who have been stupid and foolish enough to state, as the case may have been, that an Englishman was more than a match for three Spaniards, or two Frenchman, or two Germans? This was due largely to our insular position. Our politics and policies were of the fireside order, that grasped only borough councils and city corporations. In the future we will obtain our true ideals of empire and imperialism. Our policy will be turned to nations and empires and continents.

We, the greatest sea-power that the history of the world has ever known, were made up of a population, at least fifty per cent of whom had never seen the sea, and were so lamentably ignorant as to be unable to distinguish a battleship from a liner. whilst a further large percentage had never forsaken the safety of their own shores. Of these many suffered under the delusion that every Australian must be an Aborigine, that gold was to be found in the streets of Africa, the inhabitants of which country were notable for their advanced epicurean taste for missionaries, and that America was overrun with whooping cowboys and war-lusting Red Indians. This, of course, previous to the war.

This latter, and the greatest of all evils, ignorance, aviation will cure, and cure effectively. It will enable the people to travel rapidly, comfortably, and cheaply, and share with the previous chosen few the beauty, the wonder, and the wisdom of the world without, and more particularly that of the air.

Aviation will affect the psychology of every nation in that it will develop an entirely new race of men. It will eradicate the decadent side of human nature, and will build up the better side, the hunger for beauty and peace, and ever natural and wonderful phenomena of a wonderful creation. The air

can never be petty or small or mean, so neither can the beings that navigate it. This view has already been proved by the chivalrous conduct of the airmen of every belligerent power.

This new race of men will be quite a race apart; the legitimate descendants of those bold sailors the Vikings, those splendid soldiers the Romans, the Drake privateers, the Wellingtonian Bill Adams, and the men of Mons and the Marne.

They will be the missionaries throughout the world of light and hope, friendship and good feeling, education and health; and more than all of everlasting peace and democracy. For in the air the heart of every man is the heart of a king. He is "monarch of all he surveys."

CHAPTER XVIII

THE DIARY OF AN AEROPLANE

THE prospect certainly wasn't exhilarating, unless one can find matter to rejoice over in a prison forty by forty, that's as dark as blazes, cold as the arctic regions, and through the roof of which the rain percolates like a shower-bath. But I've grown used to it all now, so used that I can tell you the number of cobwebs to each corner, the exact moment the rats and mice creep out of their holes and come ambling around the shed ; almost imitate the waltzing arrogant gait of the long-bearded grandfather rats or the coy frisking of the lady mice. I can tell to a second the exact number of raindrops to each hole, and where it will drop. Ugh ! And then it collects in pools all round my frame. No wonder the poor old B.E.'s got rheumatics in every joint. Sometimes they will slide back the great front gate, but that event becomes rarer and rarer as the days go by.

Luckily for myself, I am of a philosophical turn of mind ; had I been of a nature like that cynical engine of mine, that groans at earth and sky, man and beast alike, there's no knowing what might have happened. I might have shed a wing in sheer ennui or collapsed at the under-carriage from sheer exhaustion. Instead ! But there, I wander from my story.

The last few days the most extraordinary events have taken place. Two days ago a young man, I am sure he was young, for he did not pause to stroke

bumps, treacherous clouds, and mist-hidden altitudes, until with the familiarity that breedeth contempt I had laughed softly to myself, and gone out of my way to meet cunning with cunning, and passed on unscathed. But there was something in this wide, voiceless void that held me spellbound, that filled my heart with apprehension. If it has this effect on me in the sunshine, I argued to myself, what must it be like when the sky is hidden with dark clouds, and the wind comes howling along to whip up that placid surface into a terrifying wilderness of mountainous seas?

Then I felt the pilot's hand tugging gently at my control-stick, and obediently I turned my nose downwards towards the earth. Now I could see the aerodrome we were making for. Perched like an eagle's nest on the crest of the white towering cliffs, it was neither so large nor so pleasant looking as my late home, but nevertheless it looked very comfortable and cosy, tucked away inside a semi-circular line of metal-roofed hangars.

I remained in this place for three days, and there said farewell to my cheery, blue-eyed pilot. On the third morning he came into my shed with a surly-looking, dark-haired individual with an ugly briar pipe stuck at an aggressive angle in his mouth. "Not much to look at, is she?" said briar pipe. I felt I could have slain him on the spot, and took an intuitive dislike to him there and then. "But she's a good 'un to climb," said the other; "bit moody, but all right if you humour her." "I know the kind," replied briar pipe; "their humours usually end in a nose-dive at about 3000 feet, and then——" He shrugged his shoulders expressively. They both laughed. Like their impudence!

I wasn't far out in my conjecture. My new master was a wild, erratic individual, that first sent me

rushing through the air with the speed of an express train, then plunged me down earthward like a bolt from the blue ; and banked and switchbacked me until my old—here, in the privacy of my diary, I own to the soft impeachment—ribs creaked and groaned and creaked again, until it seemed as if every moment they must fly asunder in sheer protest.

Then he landed me with a nerve-trying bump, and with a "Have her ready by this afternoon, petrolled and oiled up," to the mechanic, he disappeared to his lunch, and left me standing, cold and shivering, in the fresh sea-breeze, with my mind full of apprehension concerning my approaching flight.

He was more gentle with me in the afternoon. Perhaps he had lunched well, perhaps he had begun at last to appreciate my good qualities ; or perhaps, and what was more than likely, the sea held as many terrors for him as it did for me. Whatever may have been the reason, he no longer persisted in swinging me about, left and right, up and down, but moved the controls easily and gently. The fascination of the sea must have got into my brain, for the next hour or so I was moving as in a dream. I could feel my pilot pulling savagely away, but I did not move an inch. All I wanted to do was to get down, down to the sea. In fact, I behaved altogether most disgracefully. A point my pilot did not miss, not that that troubled me much. I was too intent on watching the vast blue waste beneath and the queer shapes that inhabited it. Northwards, to where the Kentish coast thrust nose-fashion into the sea, and a few miles distant from the shore, were the high-piled Goodwins. A lone sentinel, stiff and upright, in the blue coast mist stood the Lightship at the Knock. The fairway was thronged with shipping of all kinds. White and

slim-looking the cross-Channel boat slipped by beneath. Racing up Channel like a school of porpoises were a dozen or so dark, rakish-looking destroyers. Here and there dotted about a squat, ungainly tramp, a larger and more graceful liner, or a monitor, broad-beamed as a pancake. At last the French coast came in sight!

I knew what was coming before he landed me; my pilot was furious, perfectly furious, at my cross-Channel performance. Landing with a jerk, he sprang out of my body, and catching my ribs with a flying kick, until they shook again and again, he stalked off towards the sheds. Soon he returned with two mechanics that rubbed me down, and after feeding me up with oil and petrol, pushed me gently into my shed. "Don't trouble to cover her up, Bill," said the taller of the two. "Not cover her up?" demanded the other man. "No, she'll be going back to-morrow, she's a dud," was the reply. Then I knew my fate. I was to be sent home! In an instant all my fond, happy dreams were shattered, I was disgraced and humiliated. I was an old crock, and would, now, never be able to join my brave comrades in the battle. I nearly wept my heart out that night, and when at last the dawn broke, I was long past caring. I determined to throw myself to the earth at the first opportunity, and die. But the sun had risen far into the heavens before they roused me. I struggled violently, but it was useless. I was dragged out into the aerodrome amidst a lot of young and self-opinionated neighbours who either deigned not to say a word to me, or passed sneering remarks about my old-fashioned shape.

You can guess then how pleased I was to catch sight of my old-young friend, the fair-haired pilot, coming across the ground, arm in arm with my late

master. I felt so excited that I began to shiver with sheer joy, so that the mechanic began to think I was going to fall on top of him, and savagely kicked me again. Then the two pilots came up and stopped in front of my nose, making the sharp-eared Moranes and Nieuports throw up their noses with rage. "I don't care what you say," exclaimed blue-eyes, "I flew her for over two hours yesterday, and she was top-hole." "Pity you didn't fly her across Channel then," said briar-pipe, clenching his teeth from sheer annoyance. "She not only refused to climb, but made at least three distinct attempts to nose-dive into the water."

Alas! It was only too true, and I knew it; it must have been when I was suffering from a touch of the I-don't-know-what-you-call-its. I felt very sorry, very humble; not that I minded in the least what briar-pipe thought, but I was upset to think the fair-haired boy might agree with him.

But no! The latter told briar-pipe that it must have been due to his mediocre pilotage, and then they fell upon a violent argument concerning their respective qualities and failings as air-pilots. This much to the amusement of the other planes, who, despite their 'igh and 'aughty demeanour, plumped solid for my champion. "Well, I tell you how we'll decide," the latter went on, "I'll take her up when I go to strafe that big gun at Z—— this afternoon." How my heart throbbed within me. At last my fondest dreams were to be realized, and I was to take part in a glorious raid. My day-dreaming was interrupted by the savage voice of briar-pipe. "Very well, you do so at your own risk," he said, "and don't forget I warned you. What's it to be? Two quid—that's a bet, isn't it?"

Never had I felt so fit in my life as I did that

afternoon. The weather was sunny and clear. I had been thoroughly overhauled and petrolled. A squat, ugly Lewis gun had been installed over my nose, and my engine was working with the regularity of a piece of clockwork.

At last he came; looking strangely grotesque in brown leather coat and trousers, close-fitting skull cap, and over it a woollen Balaclava and a pair of hideous goggles. "Everything ready, Bates?" he enquired. "Everything, sir," replied the mechanic.

As we began to rise into the air it took me some considerable time to grow accustomed to the unusual weight of bombs beneath the prow. I must confess I felt a wee bit afraid of them. With these murderous implements of death, I, and of course my pilot also, were to slaughter helpless but, saving grace, not harmless human beings, thousands of feet on the ground below.

Up and up we climbed, up and up. Now it began to get cold and still. The earth was almost blotted out from sight, and now ran on all sides to the dim haze of the horizon, a mad riot of blue and white, green and grey. I had never been up so high in my life before. Desperately hard though I tried to hide my true feelings, that confounded engine began to splutter and cough. I shook it and remonstrated with it, but all persuasion was useless. It persisted with its uncanny groans. I think my pilot must have guessed, for he leant over my side, and gently caressing me with a cool, steady hand, whispered in my ear, "Steady, old girl, steady, we'll need all your energy this trip." My heart swelled with pride, until it seemed as if it must burst. At least he believed in me!

And then we turned eastward and clung to the edge of the low-lying coast. Now the country grew strangely unfamiliar in appearance. Fields and

meadows that should have been fresh and green were earth-pocked and cut about as though a giant plough had been passed over them, carrying away with it, in its mad career, crop and hedge, road and river-bank alike; stripping the trees of young foliage and scarring the earth with repulsive furrows. And round and about it all there flashed murderous pin-pricks of red flame. Tiny, crawling, ant-like figures, hurrying now this way, now that, and then a strange hissing noise filled the air. An unaccountable feeling of fright and terror crept over me. I felt the grip of the pilot tighten on the control-stick. Then in a flash of smoke and flame it burst beside me. I trembled in every plane. Gently, very gently, we climbed higher, followed everywhere by those awesome bursts of flame.

I expected the pilot to turn back, but no, he kept on and on. Now the bombardment had ceased, save for an occasional burst.

Still we keep on. The country on this side of the lines is very similar to that we have just left, scarred and earth-marked with shell-holes. A seemingly peaceful country town looms into view through the mist. A large cluster of houses, from which run roadways in all directions, north, south, east, and west; a gleaming railway line and a sluggish, winding river. To the south of the town, half a dozen tall chimney-stacks—evidently the manufacturing quarter—from which the smoke curls discolouringly and thickly heavenwards. Before the town is a dense, green wood. No more peaceful view could be imagined. Can this be Z——, where the great foundries work incessantly, where thousands of workmen labour night and day, shaping and forming every deadly implement of war?

Suddenly the green wood is cleft apart as if by an earthquake. There is a terrifying explosion, a cloud

of dense smoke, followed immediately by a long-drawn shriek and a mass of masonry and torn earthworks that goes flying heavenwards at a point far to the rear.

This is the gun we have come to demolish. We! mark you.

Everything is quiet and peaceful again now. Lower we come; lower and lower, in wide sweeping circles. Now the enemy anti-aircraft begin to open fire, now here, now there. Now on all sides the air is filled with picric smoke and bursting shells. How can we pass through it all? We bank and climb and dive, and bank again; coming lower all the time. Momentarily we are out of range, but only momentarily. Then the firing reopens with renewed intensity. Suddenly there is a sharp, stinging pain in my left wing, as if someone had suddenly plunged a red-hot knife therethrough. I lurch, only in time and with a sharp intake of breath the pilot pulls me up.

Now we sight the dull gleaming form of the gun through the trees. Down go the bombs, one, two, three, exploding on all sides, but never near the gun. Again we wheel. The bombardment grows terrifying in its intensity. We bomb again and again.

Again I feel those sharp stabs left and right. It is the most trying moment of my life. With his sixth my pilot hits the gun-emplacement. There is an explosion louder than all the rest; where the forest had shown a moment or so before green and restful, the earth is distorted with up-blown trees and strange towering piles of fresh earth.

We sneak off, like a dog with its tail between its legs, fearful, yet hoping, leaving in our wake, in place of the peaceful country town, an armed fortress, the guns of which fill the heavens with wailing, bursting shells.

Will we ever get back? I try to climb, but fail miserably in the attempt. We are winged, hopelessly winged. For a moment it seems that my pilot must give way and land in their country to be made prisoner. This is the psychological moment, now or never. With a desperate effort I climb another thousand that leaves me throbbing and panting for breath. I feel the rich, warm blood of the pilot trickling down my body. Suddenly he falls inanimate in his seat. He has been hit and has fainted. Now I can show my appreciation for his kindness. I keep as steady as a rock. Thank heaven I do not possess any infantile, sudden tricks like those skittish Nieuports.

Presently he recovers, and now my own wounds agonize with a dumb, gnawing pain. We are near the lines, we must, we shall go up. Desperately, helplessly I try to climb. The effort almost brings me crashing to the ground. There is now only one thing for it; the pilot opens the engine out to her fullest extent, we dash on as we have never done before, through a fusillade of rifle bullets, anti-aircraft and other bursting shells. I feel that I am hit in a hundred different places. Ah! can we ever reach our aerodrome again?

We are across, as if by a miracle. The next twenty minutes seems a lifetime. Can we—will we ever get there? Ah! At last!

. . . . . .

I am back in the old dark and draughty shed again, a broken, helpless crock, fit only for the wood-broker or the old iron merchant; brought back ignominiously they tell me, by rail and steamer, for all the world like a bar of iron or a mouse-trap. But then these silly, thoughtless humans still persist in regarding me as a soulless machine. I have put up a good fight, I have done my duty

and all that was expected of me. I can do no more; hence I must be scrapped. It is the way of the world, and the world can be at times, ah, so cruel!

The cobwebs are still there, more numerous if anything. And when the twilight falls the old familiar rats and mice creep out of their holes and sit round in wondering circles to listen to the stories of my great adventure, or potter round my wings to examine my honourable scars.

Now probably they will nail a brass plate on my fuselage, with an account cut prosaicly in prosaic letters thereon of the great deed. More probably I will become the *pièce de résistance* of the local red-cross show, or be wheeled through the streets, drawn by a donkey or a decrepit horse on a flag day. Perhaps cut up and made into blacklead pencils. Ah, me! It's a strange world!

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