AIRSHIPS IN THE MAKING

Today, when battleplanes and air scouts soar by the thousands over the battlefields of Europe, it is a curious thing that there is so much about the principles of aeroplane construction and the navigation of the air that are unknown or not understood.

True, the aeroplane is on an intensely practical basis now. It has been placed on that basis through painful experiment under the force of military necessity. It is made in this and that fashion only partly because the designers know why it should be made so, and very largely because successful designs have been "hit upon." For practical purposes of present need it is very good to have found that model "A" will travel at such and such a speed, that it will lift so much dead weight, that it will rise at such a speed and after travelling so many feet, and also to have found that an engine of so many horsepower will drive this or that type. But the designers themselves don't quite know all the "factors" why in the case. They are somewhat in the position of Sir Isaac Newton before that apple fell on his head. They know perfectly well that an apple will fall, and that there must be some reason why it falls, but they are not yet in position to say that they have definitely determined that reason beyond contradiction.

Mysterious "Co-Efficient K."

For instance—and this is but one most of them regard as infamous the "co-efficient K" which enters into the calculation of air resistance to a plane held at right angles to its motion against the air.

This resistance has been found to be the surface (in square meters) multiplied by the velocity (in meters per second) multiplied by this elusive "co-efficient K." Generally it has been found to be somewhere around .0.8, but the disconcerting thing about it is that the "confounded thing varies with different machines," and no one seems to know just why.

Naval construction, on a scientific basis, has had the start of decades, and on a less scientific basis the start of centuries, on aeroplane construction. The action of fluids, confined and free under pressure, has been a lot more accurately determined than the action of gases under similar conditions. The latter are harder to study in the very nature of things, and their range of action and reaction is so much greater. Yet notwithstanding all these things, the aeroplane constructors have succeeded in standardizing machines which pierce the air with greater velocity than a hurricane, under virtually perfect control of their pilots.

The basic principle of the heavier than air flying machine is, of course, the reaction of the air and an inclined surface in motion. It might be likened in a measure to that of the sailboat moving at right angles to the direction of the wind if we stretch our imagination a bit. Or with less stretch of the imagination it is the stone skipping across the surface of the pond, if we think of the pond as consisting of air.

It is simplicity itself to drive an inclined plane against the air and get a lifting power from the impact but the trouble in airplane construction is to prevent resultant complications of forces. Air pressed downward by the under surface of the plane must go somewhere.

For the instant it is compressed and thus furnishes the lifting power on which the plane floats, but it is bound to flow upward and produce eddies around the rear edge of the plane. Likewise, the front edge of the plane being higher than the rear edge, the motion of the plane forward to a horizontal direction produces for an instant a vacuum along the upper surface, into which the air will swirl and the following instant produce a downward pressure on the air. Actually none of these forces may be regarded as merely instantaneous. The succession of instants is continuous, and the result is a complex array of forces some actuating and others counter-acting the others.

Shifting Centre of Resistance.

Another vital factor is the relative position of the centre of gravity and the centre of buoyancy. In the case of a boat, which floats in a medium heavier than itself, volume for volume, it is sufficient, in a general way, to see that the centre of buoyancy is higher than the centre of gravity. The two forces, pulling thus in opposite directions, serve to steady the boat.

In the case of the aeroplane, which floats in a medium lighter than itself, the case is different, because it really does not float on the air. It floats on the resistance of the air to its motion. The "centre of resistance" takes the place of the centre of buoyancy and this centre of resistance naturally varies radically with every shift of the plane angles, with every variation in speed, with every turn to the right or the left, by which the outside end of the plane travels faster than the inside end.

A centre of gravity located below the level of the planes in an aeroplane makes for stability when traveling in a straight line, but makes the taking of a sharp curve more dangerous. On the other hand, a centre of gravity located above the line of planes makes possible very sharp turns with stability, but tends to make the machine unstable in straightaway flight.

These things must be considered by the designers in connection with the speed the machine is to develop and the character of the service to which it is to be put, for with great speed the dangers of longitudinal instability are automatically lessened, the rapidity of flight being sufficient to overcome variations in atmospheric pressure and resistance.

Aeroplanes wings may be built with absolutely flat surfaces, but it has been found that the more efficient arrangement is that which approximates more closely to the construction of the bird's wing, a somewhat curved surface, with the centre of the curve closer to the forward than to the rear edge of the wing.

It is not, however, a true reproduction of the bird's wing, for the latter is constructed for flapping as well as gliding, whereas the airplane is purely a gliding machine. The curve of the aeroplane wing is a combination of parabolic curves on the two surfaces, so arranged that when presented at the proper angle they press the air downward, beneath, and pull up against it, above, with constantly accelerating force as the air slips from the forward to the rear edge.

The aeroplane motor is a development of the automobile motor, and in its turn has had a developing effect on the automobile motor. The first step was to eliminate the necessity of the flywheel by increasing the number cylinders. To save space and length of crankshaft with consequent weakening, the cylinders Airships—1 ½

have been disposed in various fashions, of which the V-shape and fan-shape are typical. A French development which, while a little complex, has many advantages, is the rotary motor.

In this type it is the cylinders which revolve about a stationary shaft turning the propeller with them. The advantage consists in the simplicity of the cooling system, which is based on the rapid movement of the cylinders themselves. The radiator, with its resistance to the air is eliminated.

A prediction for the future is an internal combustion turbine. As yet no such engine that is practicable has been put on the market but the development of constantly increasing cylinders, giving steadier and steadier application of power in an increased number of relatively smaller impulses is undoubtedly a move in this direction.

How Fast Machines are Balanced.

In general it may be said that in the machine designed for fighting, for the "aces," it is well to have the centre of gravity high, for such machines find speed essential, and also facility of manoeuvre. With the scouting planes which poise high over the line of battle and rely on the "aces" to protect them, speed is not so essential as stability and lifting power. The same applies with greater force to the raiding machines which carry two or more men and as great a weight of explosives as possible. Consequently, in the latter types the centre of gravity is swung lower.

These points are mentioned as merely illustrative of the difficulties which confront the aeroplane designer.

It might be imagined that the designers would find aluminum an ideal material of construction. Such, however is not the case. Notwithstanding its extreme lightness, this metal does not possess the requisite strength. It cannot be used in the form of wires. They would break too easily. Its bending strength is even worse. It is not very cohesive, a fault which is aggravated by vibration.

The motor industry generally has banned aluminum and the day is coming when not a particle of it will be used in aeroplanes.

Steel is becoming more important every day, as it is one of those rare metals which resists tension as well as bending and tortional strain.

Wood is still the most important material in aeroplane building despite the fact that steel is coming into more common use. It has a resistance to vibration that is greater than steel, and when properly used is a much better material for propellers, as well as the framework of the wings.

Wood Propeller the Best

There are a certain number of drawbacks inherent in the metal propeller. They are heavy, and easily bent, and because of their great elasticity they vibrate when in use. If they burst under the strain of high velocity the pieces are a great source of danger. In the case of wood, however, with the grain running lengthwise, it has a tensile strength greater than that of nickel-steel and the danger of its flying to pieces under centrifugal force is reduced to a minimum.

If, however, such an accident does occur, the pieces, being so much lighter than metal do not constitute such a source of danger. Its lightness allows the blade to be very thick through, and to be shaped in such a way as to offer the least possible resistance to motion.

The only drawback is the difficulty of construction. Various layers of selected grain have to be glued tightly together and then the blade is turned out—and the smallest irregularity affects the efficiency of the propeller enormously. It is easy to see, therefore, that they are more expensive than the metal type.

The upper and lower surfaces of airplane wings are not the same. The curvature is quite different, a thing made necessary by the difference in the desired reaction of the air against the upper and the lower surfaces.

The planes, though very light and presenting a large surface have to support the entire weight of the machine, and while they must be flexible enough to stand without injury the shock of landing they must also be strong enough to keep their shape under the pressure of the air in flight. Wood or steel is used to fulfil these conditions in various machines.

These planes are very difficult to manufacture in the case of the more highly specialized monoplane, and hardly less so in the case of the more primitive biplane.

As the Wright planes are made generally, two flat spars are placed parallel to each other with their fore edges rounded off to reduce wind resistance. They are kept at the proper distance apart by small blocks of wood between. The rear ends are not secured, but are permitted to slide freely one on the other, thus yielding to any sudden air pressure put upon them. These rib members are then braced and held firmly in position in the wings, after which the canvas, or other material used for the surfaces, is fastened on above and beneath them.

Other manufacturers have found it well to make the ribs out of solid strips of wood. Sometimes for greater strength toward the front edge of the wing they are encased in steel tubes, with the rear ends of the ribs projecting from the tubes. Still other machines are built up entirely of steel tubing welded together.

In most of the Wright machines the canvas or outer wing covering is simply nailed to the upper and under sides of the ribs. It is a very simple method of construction, but not a good one where the machine may have to be dismantled and assembled in a hurry. Sometimes the manufacturer will glue the surface material on, while in some types the two surfaces are made in the form of a bag, which may be stretched tightly over the framework of the wings and then laced together.

THE KING'S EXHORTATION.
The King's exhortation to the nation to economize in the use of bread was read from the Royal Exchange and warmly cheered. All that remains is to put it into practice and defeat the "devices of our enemies." Photo shows the City's Common Crier reading the proclamation.

BORDER WATCHED.
By Courier Leased Wire.

Detroit, May 25.—Thousands of persons attempting to come to Detroit from Windsor, Ontario, this forenoon, were detained at the ferry station by Canadian officials who began rigid enforcement of the Dominion's military laws. No person of military age was allowe dto board a ferry until he had convinced the officials that he was not seeking to avoid conscription. Every person passing through the ferry gates was questioned and great congestion resulted. Most of the Windsor residents who are employed in Detroit were detained at least an hour at the station on account of the crushing.

EAST IN DANGER.
By Courier Leased Wire.

Petrograd, May 25—via London—Minister of war Kerensky speaking at Helsingfors before starting on his tour of the front, referred to the military situation in Asia Minor, of which the official news agency quotes him as saying: "There is danger not only of losing Armenia but possibly part of the Caucasus."
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The delegates to the "Win-the-War" convention at Quebec received a warm welcome all the way down from Montreal.

Napanee in one day contributed $1,800 for the Y.M.C.A. war work, $300 more than aimed at for the whole campaign.

Belleville school children were asked to each donate a seed potato for a plot of land owned by the Children's Aid Society.

Anton Baizola, president and promoter of the Niagara Spanish Aerial Car Tramway over the Whirlpool, died suddenly.