The Secret Experiments of the Wright Brothers

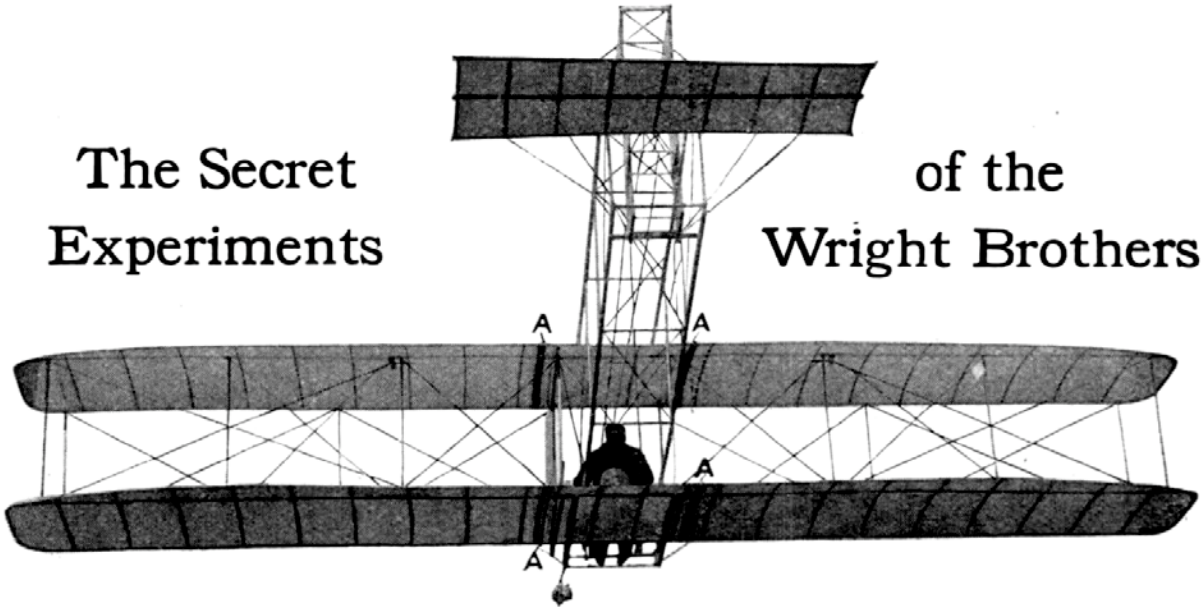


Fig. 1—View of Wright Glider from Below

SO many extravagant stories have been printed concerning the interesting experiments with a new glider, which the Wright brothers have been making of late at Kill Devil Hills, N. C., that Popular Mechanics Magazine sent an acknowledged authority on aviation to North Carolina to write an accurate and complete description of the machine and of results secured, together with an expert analysis of the technical significance of the work.

DESPITE the wild tales that have been filling the newspapers of late, to the effect that the new Wright machine was a flapping-wing device, that it was a solution of the problem of flight without power, that it was capable of hovering indefinitely over a selected spot, and that it was capable of imitating the soaring flight of the larger birds, it proves upon first-hand investigation to be only slightly different in appearance and performance from previous Wright gliders and power machines—over which it discloses improvement only in immaterial and minor degree, if at all. Probably the Wrights themselves would claim little more for it, though their customary reticence has been in this case, as before, taken as evidence of mysterious and marvelous achievements—by newspaper writers with more interest and enthusiasm than technical competence.

Undoubtedly this attitude on the part of press and public has been inspired largely by the vague but not ill-founded idea that soaring flight with aeroplanes, with use of power only occasionally, if at all, is an impending development in this field of engineering. And while it is not the fact that the Wrights have really achieved such flight in the present experiments, they have unquestionably made a greater or less step toward it; and that still greater progress will be made in the near future by them or by others is not to be doubted.

To those who were so fortunate as to see the flights with the new glider, even to the technical experts who have some idea how they are accomplished, it was nevertheless little short of miraculous to observe the Wright structure of wood, wire and canvas, apparently under the absolute control of the operator, with no visible source of power, perform its amazing feats. To see it poise itself for seconds, even minutes, at a time, apparently in defiance of the law of gravitation, then advance steadily into the teeth of a driving gale, which by all that seemed reasonable, should have driven it backward; again, finally, to see it lose ground, back up, and settle with hardly a tremor, at the starting point, had all the seeming of something miraculous.

Orville Wright Making Observations during the Trials with the New Glider

At other times in the course of the trials, a most pretty sight was the extreme manipulation of the wing warping to balance the frail craft as it hung suspended in the invisible medium that so securely supported it. And, again, there were graceful, swooping maneuvers and hair-raising dives, by which the younger Wright brother exhibited his seemingly complete mastery over the element that from the beginning of time has been regarded as the particular realm of the creatures of the air, with whose dominion of the atmospheric ocean it was so long supposed mankind could not hope to dispute.

The crux of the problem, as hereinafter suggested, is the utmost possible flattening of the gliding angle together with the greatest possible development of the "tangential," as the obvious means of preventing loss of height even when only very slight rising currents are available. Using this condition as a test of the newest Wright experiments, there can be no question but what in their new glider they have secured a somewhat greater flattening of the gliding angle than has been achieved by any other constructor. But that it is very materially flatter in the case of the new Wright glider, or anywhere near as flat as in the birds, is a claim that does not appear tenable. Nevertheless, it is, in a sense, of all the greater significance that, with so slight a degree of improvement, it should become possible to make such remarkable hovering and rising flights into strong winds as have been made by the Wrights with their new machine.

The Kill Devil Hills were made famous by the classic original gliding experiments of the Wright brothers, which culminated in a short but successful flight with a power machine late in 1903. In many respects the place is ideal for the purpose, its remoteness and inaccessibility precluding all possibility of spectators numerous enough to be troublesome, while the high sand dunes and the sandy flats afford excellent places for starting and safe places for landing. In addition to these requisites, the prevalence of steady winds of ample velocity throughout considerable portions of the year peculiarly adapt the locality to gliding experiments of the character under consideration. It is said that the Kill Devil Hills were originally recommended to the Wrights by Langley, and were promptly chosen as the site of their first work, after a brief correspondence with the nearest postmaster.

The Hills are a group of shifting sand dunes, ranging up to a possible maximum of 100 ft. in height, rising from the almost uniformly barren surface of a long, low, and narrow sand spit that extends southward along the North Carolina coast from Cape Henry to the entrance of Albemarle Sound. The island is nowhere more than about a mile and a half wide. The nearest point on a railway is Elizabeth City, N. C. From here a daily

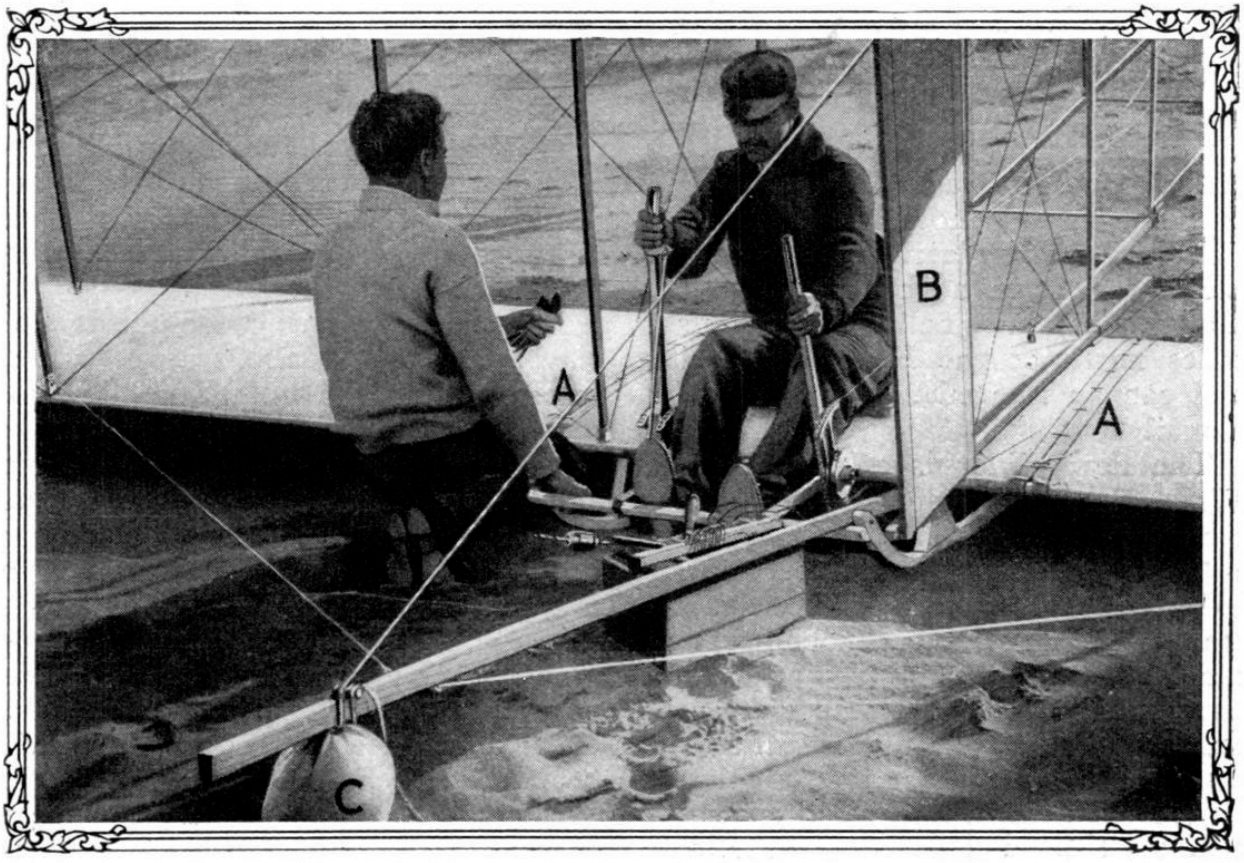


Fig. 2—Orville Wright Seated in the Glider—A, Joints in Wing Surfaces; B, Vertical Fin; C, Adjustable Weight for Balancing

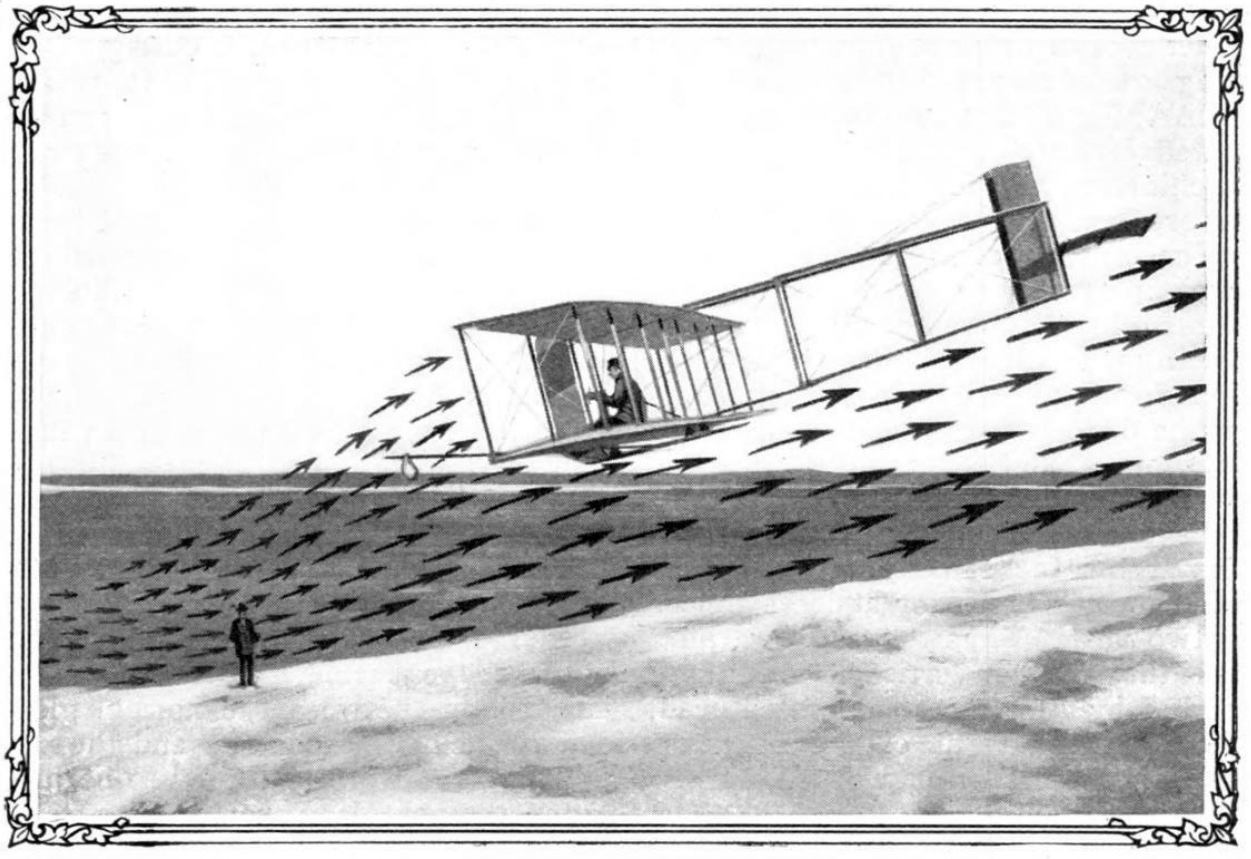


Fig. 3—Arrows Indicate 50-Mile Wind, Showing How Machine Was Sustained in a Stationary Position

boat covers in five or six hours the 50 miles to Nag's Head, a fishing settlement some 5 miles south of the Kill Devil Hills, and to Manteo, a village of 500 population across the sound on Roanoke Island—noted for its important part in the early settlement of the North American continent. Kitty Hawk, another small village, is six miles north of the Kill Devil Hills, and can be intermittently reached by a mail boat.

The new glider is a characteristic Wright biplane, with a span of 32 and a chord of 5½ ft. Its weight is about 145 lb. The wings are said, and appear, to be identical with those of one of the standard Wright power machines, and are correspondingly thin, and flat in curvature. The two surfaces are separated by eight pairs of vertical struts, no different from those long employed in Wright aeroplanes, which space off the total span into seven sections. As heretofore, the center section is made narrower than the others, and for convenience in shipping is made readily separable from the portions on either side of it. The junctures in the wing surfaces are very apparent at AAAA, Figs. 1 and 2. The operator is seated directly in the middle of the machine, on the forward edge of the lower plane.

The center section and the two first sections on either side of it are rigidly trussed in all directions by diagonal bracing wires, leaving the first two sections from each wing tip free to undergo the distortion involved in the wing warping. This is accomplished, as is clearly shown in Fig. 2, by identically the same elements that have been employed for the same purposes in all Wright aeroplanes for at least a year or two past. Thus the wing warping and the double vertical rudder are worked by a lever with a jointed head, placed at the right of the operator, while the elevator is worked by the lever at the left.

Unlike previous Wright gliders, but like all recent Wright power machines, the single flexible elevator surface is placed at the rear. A square-ended tail surface is illustrated only because one of standard form that was available became broken in an accident.

Both vertical and horizontal tail surfaces are carried on a light skeleton box girder similar to that used on the power machine.

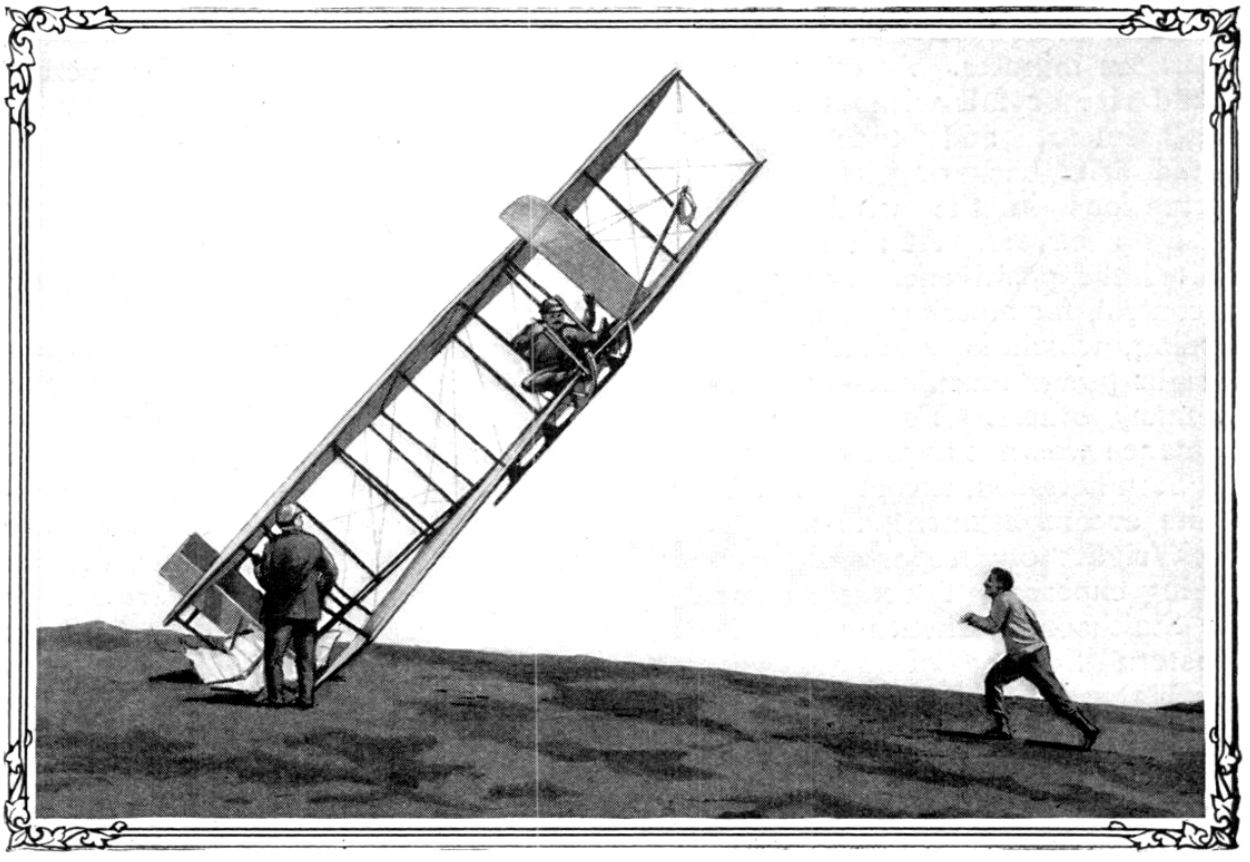
A curious-appearing feature is the single vertical fin, about a foot wide, which extends the entire height of the machine just in front of the main planes, and to the left of the operator. This is, however, simply an equivalent of the fin-like "blinkers," similarly present in all but the very earliest Wright biplanes.

The runners resemble those on early gliders, being much lower than are now used on the power machines. They are, indeed, barely sufficient to keep the lower plane off the ground. Presumably the design of this detail is dictated by a desire to secure the utmost minimization of the head resistance.

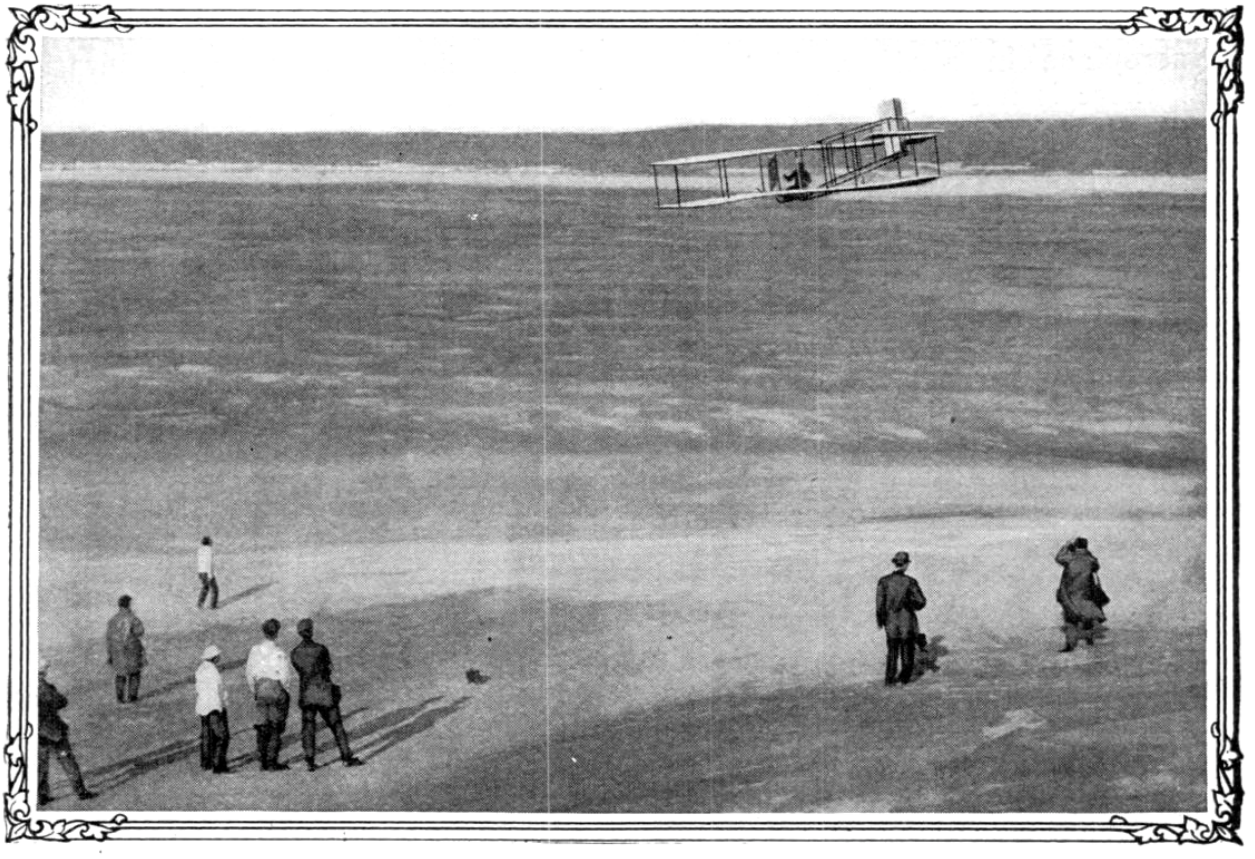
For securing very exact adjustment of the longitudinal balance of this experimental glider, there is outrigged in front a boom (C, Fig. 2), to which there is attached a weight that can be conveniently varied in quantity or shifted in position.

The glider has been tested by releasing it from a hilltop into winds ranging up to 50 miles an hour, in the manner sketched in Fig. 3, every condition being especially selected to secure the utmost possible advantage from the strongly-rising wind, as it is deflected upward by the slope of the hill, in the manner indicated by the arrows. It is a well-understood effect of sloping ground that it upwardly deflects wind flowing over it.

The results secured were quite what would be expected. At times, when the balance between the normal gliding speed of the machine and the velocity of the wind happened to be just right, the aeroplane would poise itself in a maintained position over the ground, without advancing or receding. On one occasion it thus hovered for



An Accident Which Broke the Rudder—Warping of Wings in Attempt to Control Glider is Noticeable



The Aeroplane Hovering in a Wind. Note How the Coats of the Spectators are Blown Back, and the Clearly Evident Distortion Due to the Wing Warping

about ten minutes. At other times it would rise or fall without horizontal displacement, and then again it would drift back or glide ahead, as fluctuations in the wind facilitated these maneuvers. At all times it exhibited the positiveness and certainty of control, for steering, balancing, and landing, which is a feature of the Wright power machines—and, indeed, of many others. Yet, that the performance was not as wholly new as it has been heralded, except in the degree of its accomplishment, is attested in the Wrights' own reports of their first gliding experiments, communicated to the Smithsonian Institute and to the Western Society of Engineers, in which there is mention of brief hovering and gain of height in winds blowing up sloping ground.

It is a curious feature of these experiments, and of the many misstatements that have been made concerning them—wholly without the approval of the Wrights, of course—that the average mind finds it so difficult to visualize the phenomena that affect an aeroplane in a wind. To begin with, there is not the distinction that is commonly assumed between gliding with a motorless aeroplane and gliding with a motor aeroplane with the motor stopped—the latter the *"vol plane"* of accepted aviation terminology. Wherefore the record for gliding flight logically belongs, in all reasonableness, to whomsoever has accomplished the longest *vol plane*, rather than to some one who may have made a shorter glide with no motor in his machine instead of with the motor merely stopped.

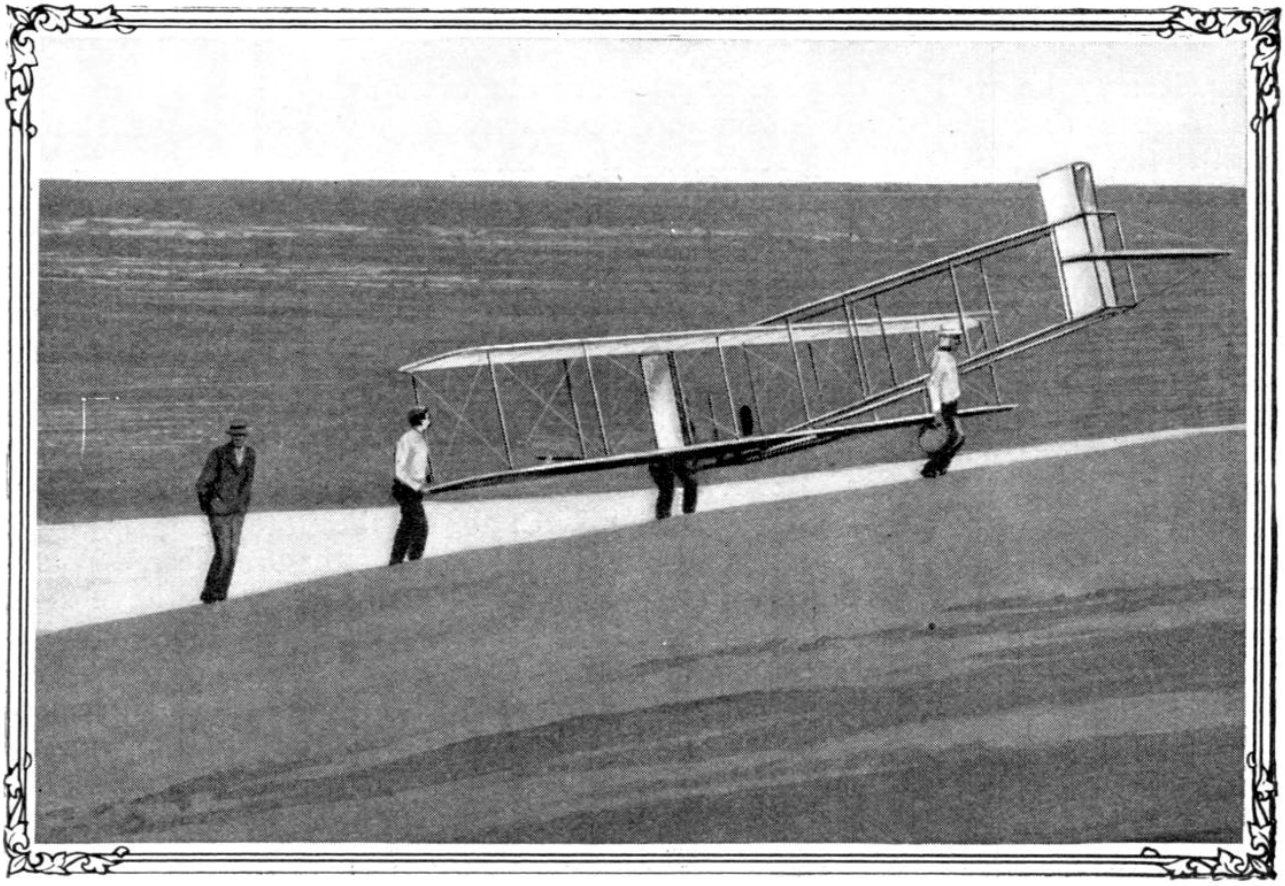
About the matter of hovering other misconceptions are rife. It is well understood that to secure sustention from the air, an aeroplane must be in continuous lateral * movement, but what seems not to be so well understood is the fact that this lateral movement requires only to be *through the air*, and sustains only a most incidental relation to the ground. The consequence is that if the whole body of the air is drifting, in the form of a wind, across the earth's surface at a speed, say, of 50 miles an hour, an aeroplane running into this wind at 50 miles an hour will be normally sustained without making any progress over the ground whatever—in other words, while hovering. But relatively to the air that sustains it, it will be moving normally. Conversely, if the aeroplane turn and travel *with* the wind, in securing sustention at its normal speed there will be added to this the wind speed, combining to make a speed over the ground of 100 miles an hour, despite the fact that it is moving *through the air* just 50 miles an hour, as before. The condition may be likened to that of a fly in a railway coach, moving about unconscious of the fact that the body of air in which he flies is moving rapidly over the earth's surface. Another analogy is the case of a steamer forging against a rapid river current, and making speed in respect to the water, but little or none with reference to the banks of the stream.

Of course the extreme conditions, of complete doubling or nullification by wind of an aeroplane's speed, are unusual, but less extreme conditions, involving the same principle, are common to all aeroplane flights not undertaken in a dead calm, and in which there are all degrees of minor additions to or subtractions from the actual speed of the vehicle by the effect of winds. And in at least one recent instance, which was observed at an English flying ground, a power-driven aeroplane was seen to hover for some seconds when its own speed and that of the wind happened for a moment to coincide.

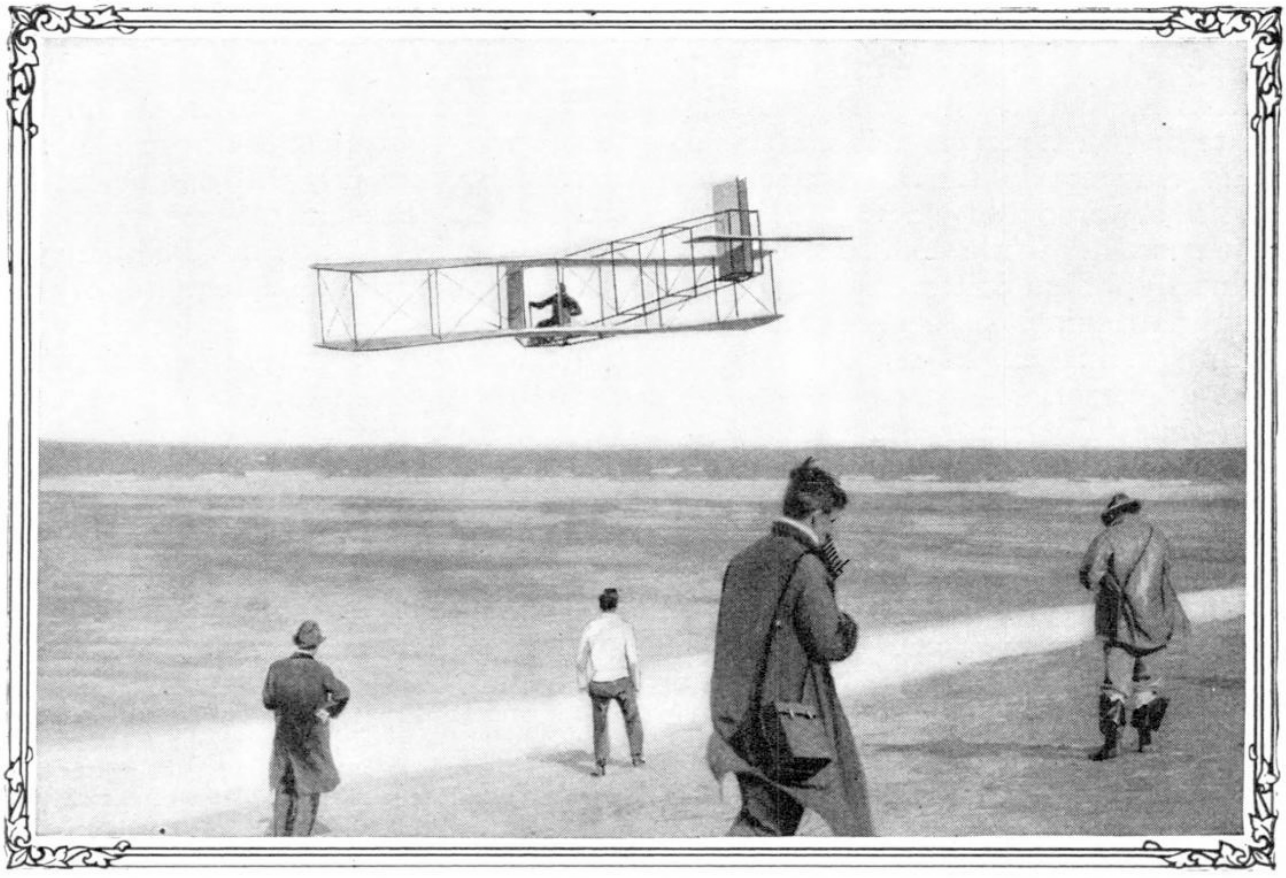
In ordinary gliding, as distinguished from flight with a motor, some source of power is just as necessary as in the other case, the only essential difference being that gravity now supplies the energy by the simple process of compelling the machine to lose height. An automobile does not need a motor to coast down hill.

Further to clarify these explana-

* The word "lateral" is now being used by aeronautic writers in the sense of horizontal movement forward.



The Glider being Carried Up the Hill for Another Trial



Another View of the Machine Hovering. Note the Extreme Use of the Wing Warping

tions, it may be well to emphasize a few points that are more obscure. First is the fact that any wing surface, at a fixed angle and with a constant loading, has a certain critical speed at which it is normal for it to travel, and at which the resistances it opposes to movement through the air are a certain fixed percentage of its weight—the "lift and drift ratio" of the engineers. To overcome the drift resistances, it is necessary either to provide propeller thrust of corresponding magnitude or else to resolve the weight of the machine itself into a propelling component, by coasting it downhill in the air, so to speak.

With an understanding of the foregoing, several matters become clear. At once it is evident that a most important field for aeroplane development lies in the direction of improving the lift-to-drift ratio—in a glider, flattening the angle of coasting necessary to sustain the craft, and in a power machine, reducing the measure of propeller thrust and horsepower required. A less evident, but not less real advantage of flattening the gliding angle inheres in the possibility it opens up of taking extensive advantage of rising currents in the atmosphere as means of propelling aeroplanes, for such currents, while common, are not ordinarily of sufficient magnitude to sustain machines of such excessively abrupt gliding angles as are now almost universal.

In thus taking advantage of rising currents, after much the same manner that is probably employed by the soaring birds, the particular essential always must be a gliding angle so flat that the machine loses altitude slower than the air rises, thus continuing indefinitely to coast down an invisible hill that rises faster than the vehicle slides down it.

Despite their unwillingness to make premature announcement of their opinions or plans, it is safe to infer that something of the foregoing is what the Wrights have had in view. To secure results, however, they have seen fit to commence by working in exceptionally vigorous rising winds, in preference to depending upon any prospect of securing exceedingly flat gliding angles.

The "automatic balancing," concerning which the daily newspapers had much to say, was not tried out. It is understood, however, to have contemplated only a test of the long-patented but little-exploited pneumatic and other devices the Wrights have proposed for this purpose. It is also asserted that the present plan is to balance automatically by ailerons hinged to the wings, so that the normal hand control by warping will not be interfered with. Presumably the policy in this is to avoid depriving the operator of the normal manual safeguards while the automatic device is tried out, rather than to substitute permanently the ailerons for the, in every respect, more effective wing warping.

ASHEVILLE, N. C., AS A HEALTH RESORT

In the ninth of the series of articles on "The Kingdom of Dust," which appeared in the October issue, the following statement was made:

"Unfortunately, the chosen places of the earth, climatically speaking, such as Denver, and Asheville, where the natural conditions are most favorable for patients suffering from tuberculosis, have become hotbeds for the growth and dissemination of the disease."

Dr. L. B. McBrayer, Health Officer of Asheville, N. C., takes issue with the author of the article. He declares that Asheville takes every known precaution to prevent the dissemination of tuberculosis. While it is undoubtedly true that the congregation of persons afflicted with a communicable disease will spread that disease unless rigid sanitary precautions are taken, and while a few years ago a theory was held by physicians which would have warranted the assertion made in the article, it is recognized that most well-established sanitariums and resorts are now actually freer from bacilli than the ordinary factory or home where an unsuspected case may exist or where a careless patient works or lives.

The Asheville Health Department is active and efficient in carrying out its laws for the prevention of tuberculosis. A recent bulletin of the department begins with the following statement:

"Asheville opens wide her doors to the sick and well from every clime, but she demands that the sick shall so comport themselves that they shall not become a menace to the health of her citizens or the stranger within her gates."