DOWNWIND *Turns* AND DOWNWIND *Flight*

By Arthur B. Schultz

A symposium on the effects of wind velocity gradient on the flight characteristics of aircraft.

EDITOR'S NOTE: *There is probably no better or more convincing place or way in the world to observe and appreciate velocity gradient than flying a glider on a low ridge under a condition where the wind is as far off the ridge as it is possible to have it and still maintain flight. Under the above conditions it will be found that the flight upwind feels firm, the ship flies high and controls are sensitive. On the return trip downwind, even the best of pilots will sink lower and have a decided feeling of sloppy flight and insecurity.*

It is possible for conditions to be so severe that although flights upwind are relatively good and safe, the return downwind leaves one every time below the top of the ridge. When the wind has swung off the ridge to a point where conditions even approach this serious flight problem, a good pilot will always land at once—coming in out of the upwind pass, of course.

Much decisive data has been recently published covernig the subject of downwind turns and downwind flight at low altitudes. It is the object of the present article to assemble this data and present it in a simple form that can be readily understood by everyone.

Figure 1 is reproduced to emphasize the fact that velocity gradients in the wind really do exist. Many confirming observations have been made, but perhaps the most convincing argument is that farmers always hang their windmills high to get them up in the strongest and steadiest wind, even when there are no obstructions.

Figure 2 indicates the turbulent conditions which prevail over the terrain which most of us fly. Various barriers such as rows of trees, woods or groups of buildings upset the gradient flow of figure 1 causing rollers of air to form upon which the upper layers of air seem to roll along. Observations of the irregular vertical movements of a path of smoke left by a locomotive seem to fully substantiate this, but other data are available. "Squally" winds experienced by sailors indicate that these rollers frequently exist even when no physical obstructions are present.

Regardless of whether smooth gradients or turbulent rollers happen to exist, either one will produce certain detrimental effects on a plane which, if not clearly understood and compensated for, may cause serious trouble.

Figure 3 is reproduced to point out that the depth of air involved in giving lift to an aircraft is a very tangible amount, being roughly equal to the span of the wings. This has been often substantiated by observations of aircraft entering clouds wherein the vortices left in the path of the ship show this phenomenon very clearly. It is important to note that this depth may be approximately equal to, or may be only a fraction of, the depth of the gradient or diameter of the rollers.

Figure 4 is reproduced to present one way of looking at the reason why wings lift. It is common knowledge that the air passing the wing is slowed up below and in front and speeds up as it passes over and back of the wing. According to the Bernoulli theorum of our high school days, this will cause a pressure on the bottom of the wing and a suction on the top, resulting in a sum total of what we call lift.

(*Continued on page* 8)

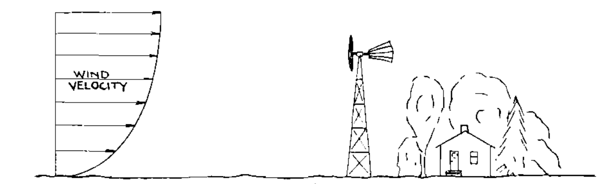

FIGURE 1.

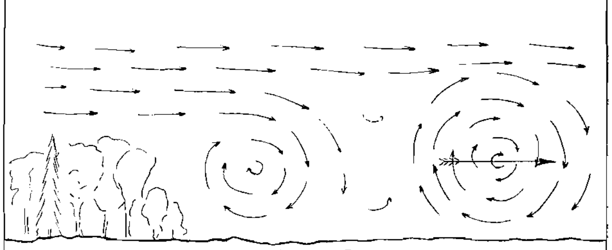

FIGURE 2.

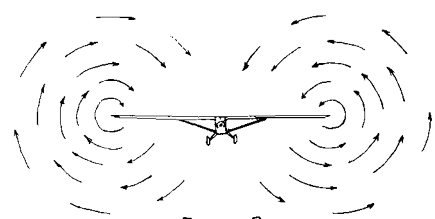

FIGURE 3.

Soaring

Published Monthly as The Official Organ of
THE SOARING SOCIETY OF AMERICA, INC.

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Subscription rate—$2.00 per year