Something for Nothing

by BARRY SCHIFF / AOPA 110803

Using soaring techniques to get more out of your airplane

■■ Charles Lindbergh was known to many for more than his historic flight to Paris. To some World War II Navy pilots, he was also the maestro of long-range cruise control.

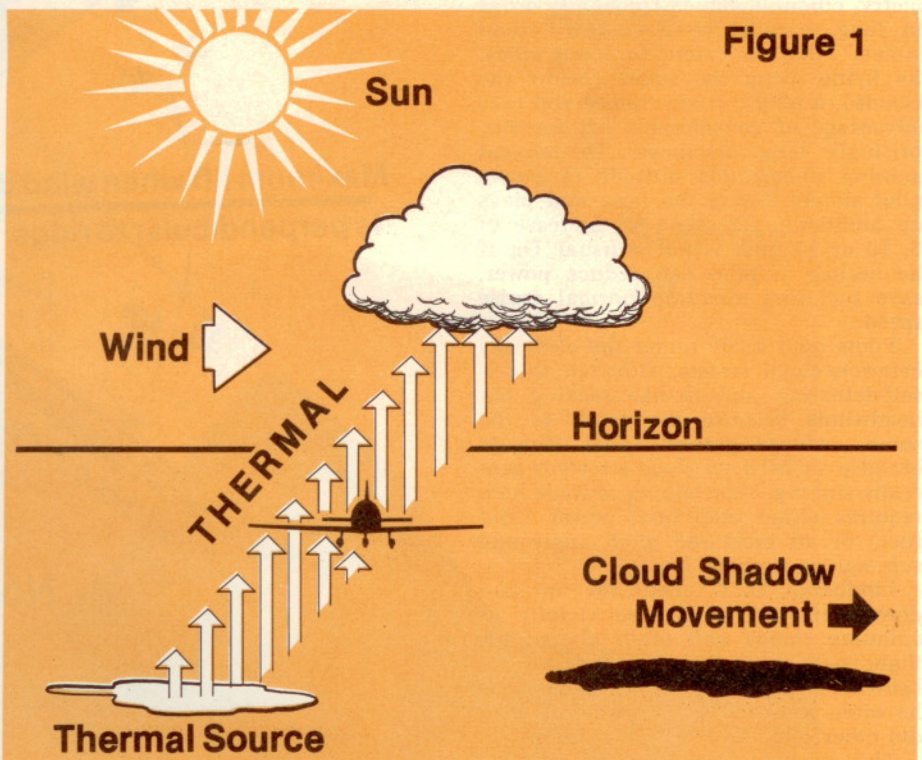
On several occasions, Lindbergh took off from an aircraft carrier and returned with considerably more fuel than others who had flown the identical mission. This happened often enough to rule out luck or a particularly efficient airplane.

One of Lindbergh's techniques recognized the advantages of flight through rising air and the penalties paid when flying through descending air. He skillfully used convective (vertical) currents to extract energy from the atmosphere, free power that can supplement lift, reduce fuel consumption, increase airspeed, or achieve exhilarating rates of climb.

Of course, none of this is particularly earth shaking to sailplane pilots. They began developing similar skills before the Wright Brothers had ever heard of Kitty Hawk. A few have accomplished some truly extraordinary feats. Consider Paul Bikle, who soared to 46,267 feet msl in his Schweizer sailplane, or Hans Grosse of West Germany, who flew his ASK-12 for a non-stop, straight-line distance of 908 miles.

No, there was nothing new about Lindy's ability to take advantage of the rising currents of air, but he was one of the first to successfully and dramatically demonstrate the feasibility of applying these techniques to *powered* flight. The lessons he taught to Navy pilots are even more valuable to those who fly light, general aviation airplanes.

There is a fascinating, enjoyable method by which soaring can be practiced in your own airplane (without shutting down the engine). But before the fun (described later), some time



needs to be spent in the classroom.

Since the atmosphere is three dimensional, a pilot needs more than a working knowledge of horizontal air motion (wind). Vertical currents also should be considered. It is important not only to know when and where to expect rising air, but also how to avoid sinking air, something that can seriously erode performance.

For practical purposes, air rises only when it is heated from below (convection currents) or when it is lifted mechanically (orographically) by a mountain slope or other obstacle to the wind. (Although sailplane pilots also utilize mountain waves and frontal slopes, these sources of lift are not as useful to powered flight.)

Most pilots are aware of thermals, those columnar bubbles of relatively warm, rising air that usually produce a turbulent ride. When a thermal is sufficiently strong and contains sufficient water vapor, it results in a cumulus cloud, a visual signpost that usually represents the thermal's uppermost limit. As every sailplane pilot knows, a rich column of lift usually can be found between the source of the thermal and the cloud base. But one cumulus cloud (or thermal) is normally not of value to a power pilot.

Fortunately and because of Mother Nature's propensity for order and symmetry, cumulus clouds frequently occur in long, parallel rows (called "cloud streets") that can extend for many miles. By flying along the street (below the clouds), a pilot can experience and take advantage of considerable lift for surprisingly long distances. To prevent gaining undesirable altitude, a power pilot simply lowers the nose and picks up additional airspeed. An increase of 5, 10 or 15 mph is not unusual. Or, if he desires, a pilot can reduce power, save fuel and maintain normal cruise speed.

Pilots tend to fly under the clear sky *between* cloud streets, although this is self-defeating and is like seeking out headwinds because the result is the same—reduced ground speed. This is because air between cloud streets is generally sinking. Maintaining altitude here requires either additional power (and fuel) or an increased pitch angle and subsequent airspeed loss.

Lindbergh knew about the up- and down-draft activity in the vicinity of cumulus clouds and often altered his flight path to take advantage of the beneficial currents. Little wonder that he often returned with more fuel than did other pilots not so well informed.

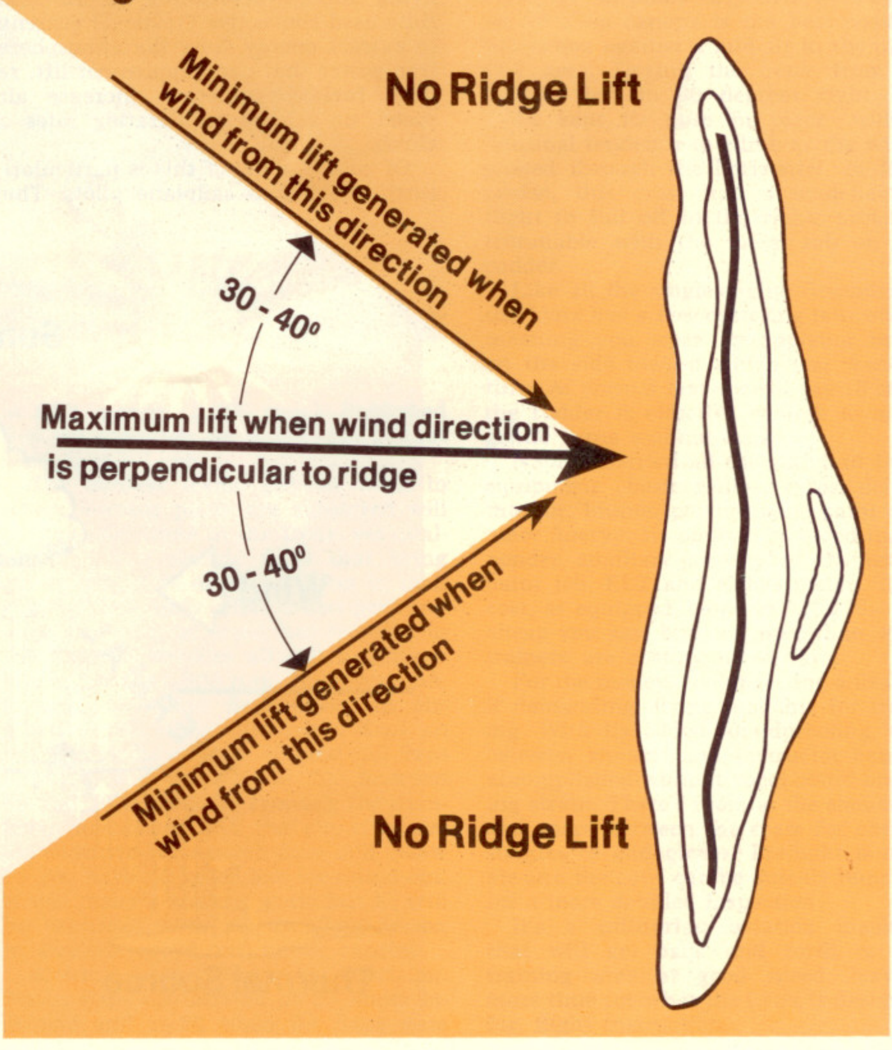
The buoyant air feeding cumulus clouds does not always rise vertically, however. If there is a wind, a flight two or three thousand feet below the cloud base might miss the rising current entirely.

Figure 1 demonstrates that when the wind is blowing, the flight path should be downwind of the thermal's source and upwing of the cloud base. When uncertain of wind direction (or speed), simply spend a moment observing the movement of the cloud's shadow. (None of this is meant to imply that pilots should fly under the base of a thunderstorm or even a massive and towering cumulus cloud; this discussion deals with fair-weather cumulus.)

If thermals do not contain sufficient water vapor, the vertical currents can be used even though cumulus clouds do not develop to point the way. Instead, thermals must be located at their sources such as small towns and factories that radiate considerable heat. In open country, look for contrasts in soil and fly over (or near) those areas that appear driest (moist soil, areas of vegetation and bodies of water usually do not generate significant thermal activity). Over mountainous or hilly terrain, the south-facing slopes exposed to the sun generally breed thermals better than north-facing slopes or valleys.

Sometimes, such as when overflying a desert or vast plain, it's impossible to tell where the thermals originate. It's simply a matter of flying from lift to sink to lift, etc. At such times, improved performance (or reduced fuel burn) still can be achieved. When flying through updrafts, take advantage of them by accepting altitude gains and reducing airspeed slightly to remain longer in the surges of lift. When in a downdraft, resist the urge to raise the nose to avoid losing altitude. This prolongs travel through the sink. Instead, accept the

Figure 2



altitude loss (and possibly increase airspeed) to get out of the area as soon as possible to minimize the negative effects. This technique also can be used when *crossing* cloud streets.

If the air is smooth and stable or the day is characterized by strong winds or stratiform clouds, forget about thermal assistance and wait for another day . . . or . . . try flying the ridges.

Lift can be found on the windward side of mountains and hills when the wind direction is within 30° to 40° of a line perpendicular to the ridge (Figure 2). The wind speed required to generate sufficiently strong lift depends, of course, on the slope of the mountain or hill. The steeper the slope, the better.

Conversely, flight in the lee of a ridge should be avoided. This is an area of steady downwash that can erode performance subtly and make pilots wonder what is going on. Often, the condition is attributed to factors that are of little or no significance. The difference in airspeed between flying on the upwind and downwind sides of a ridge can be 10 to 30 mph, depending on wind velocity, slope steepness and the proximity of the aircraft to the ridge.

To maximize the benefits, fly relatively close to the upwind side of the ridge at a position approximately 45° above the ridge line (Figure 3). A pilot can experiment and find the area of maximum lift by slightly adjusting altitude and position relative to the ridge. Also, follow the ridge contour as closely as possible unless, of course, this necessitates unnecessarily large course changes. The additional time required to fly the longer distances may outweigh the advantages.

If any large breaks occur in the ridge, fly across these as rapidly as possible to avoid probable sink.

When a proposed flight parallels a lengthy ridge line and the necessary crosswinds prevail, altering course (within reason) to remain near the upwind side of the ridges can pay handsome dividends in performance.

Soaring principles can be applied beneficially not only during cruise flight, but also after taking off in a heavily loaded (or under-powered) airplane at high density altitude. Instead of pointing the nose randomly and accepting a sickly climb rate, check the surroundings to make sure you're not in an area of sink. Then, fly toward sunlit slopes or other areas where convective lift can be expected. With respect to the wind, fly to and remain on the windward sides of any nearby slopes.

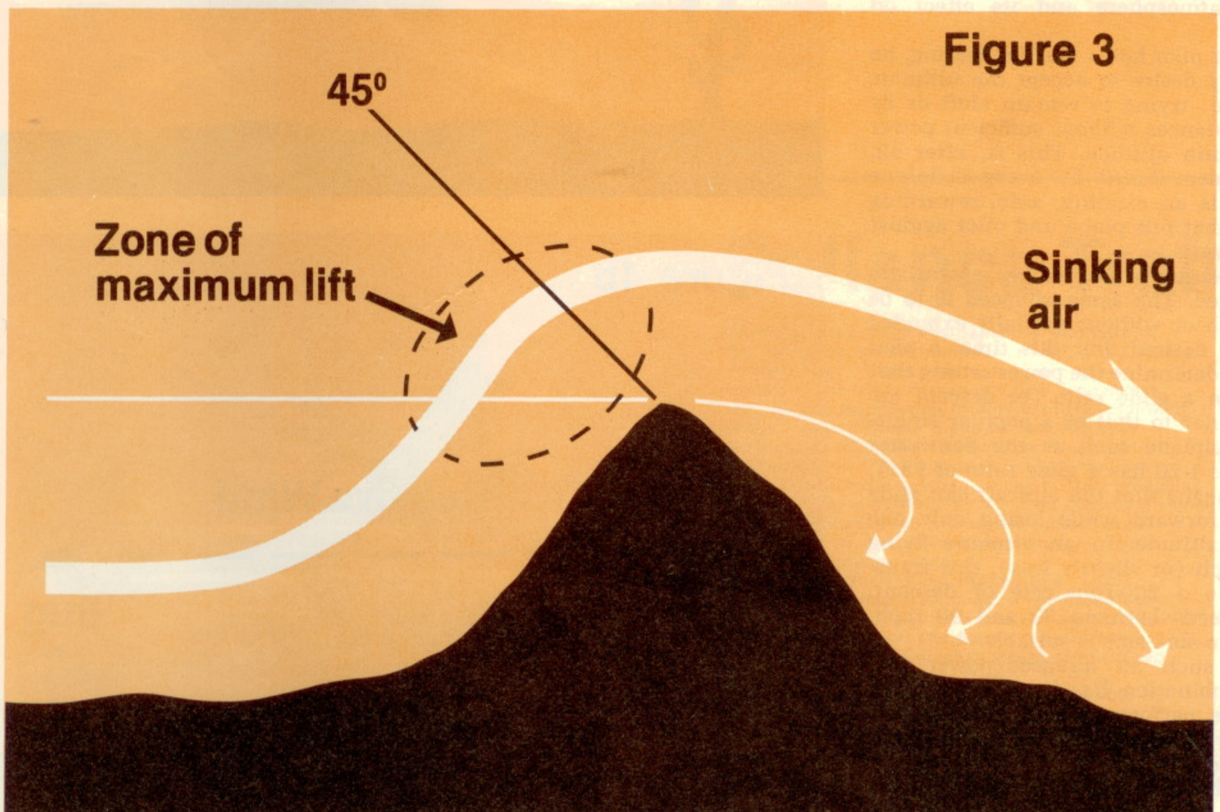
The intelligent pilot will decide on the most efficient departure route (with respect to help from rising air or hindrance from sinking air) *prior* to takeoff. A working knowledge of the atmosphere's third-dimensional movement can improve climb performance dramatically, to say nothing of avoiding excessive and potentially damaging engine temperatures.

Although mechanical and thermal lift can significantly increase flight performance, the benefits often are difficult to observe. This is due primarily to the camouflaging effect of engine power and the average pilot's inability to visualize the undulating currents of air. On a given day, for example, a pilot might say this about his airplane: "Wow, she's really fulla spunk today." Is the airplane really feeling its oats or is a gently rising air mass lending a helping hand? Often, it is the latter.

A sailplane pilot (don't ever call him a glider pilot), on the other hand, depends on outside sources of lift. Every nudge of air must be correctly interpreted. Otherwise, his flights are short-lived.

His task is simplified, however, by flying his craft at relatively slow, aerodynamically efficient airpseeds. He knows the rate of descent to expect in still air. Any variation of this rate represents the presence of lift or sink.

But a sailplane is not required in order to learn similar lessons; soaring can be practiced in an airplane without the risk of running out of lift and having to suffer the sailplane pilot's em-



barrassment, an en route, off-airport landing.

Now for the rules of the game. On a smooth, stable day and while maintaining altitude, reduce airspeed to some arbitrarily chosen, slow, efficient airspeed. For the purpose of this exercise, it is satisfactory to use that airspeed recommended for the optimum glide.

If this airspeed/power combination results in an uncomfortably nose-high attitude, extend the flaps no more than 25%. Although additional power probably will be required to maintain the same airspeed, the aircraft body angle will be reduced (in most airplanes) which increases over-the-nose visibility.

Once the required power setting has been determined (flaps up or extended partially, your choice), either wait for a day of good thermal activity or proceed toward an area where ridge-induced lift can be expected.

The idea is to precisely maintain the best glide speed and a constant power setting while paying careful attention to the VSI (vertical speed indicator), the altimeter and the seat of your pants. If a climb is detected, you're soaring; if a descent is noticed, you're in sink. With practice and the proper conditions, you'll find it possible to gain considerable altitude without varying airspeed or power. The goal, however, is not simply to taste the exhilaration of soaring, but to learn where and under what circumstances lift can be used to advantage and to confirm in a very realistic manner the workings of the atmosphere and its effect on flight.

Once a pilot has a feel for soaring, he then may desire to accept the ultimate challenge: trying to remain aloft or fly given distances *without* sufficient power to maintain altitude. This is, after all, the problem faced by every sailplane pilot. It is an exciting, safe, rewarding contest that pits plane and pilot against the elements.

The contest rules remain essentially unchanged. The same airspeed is to be used with or without partially extended flaps, as desired. But this time, a pilot needs to determine the power setting that results in a glide ratio (or descent angle) similar to that of a popular single-place sailplane such as the Schweizer 1-26. The 1-26 has a glide ratio of 23:1, which means that the aircraft can glide 23 feet forward while losing only one foot of altitude. In an airplane flying at 70 mph (or slightly less), this translates into a 200-fpm rate of descent. At airspeeds between 70 and 90 mph, a 300-fpm sink rate is suitable.

Once such an airspeed/power/sink rate combination has been established, the glide performance of the airplane will very nearly simulate that of a true soaring machine.

Now head for an area of suspected lift and, once there, see just how long you can remain aloft or how far you can travel without changing the predetermined airspeed/power configuration. With practice and under the right conditions, this exercise can prove beyond a doubt the extent to which vertical currents can influence performance.

Any discussion of up- and downdrafts invariably leads to the question, "Can a strong downdraft force an airplane to the ground?" After polling 27 instructors about this, I found that 21 (including two FAA examiners) believed this to be impossible.

Their reasoning was, in essence, that as a descending column of air approaches the ground, it is forced to spread horizontally (Figure 4a). In other words, the vertical component of the downdraft weakens rapidly near the ground and affords the airplane an opportunity to escape the grip of involuntary descent.

Sound logical? Of course. But is the answer correct? No. Figure 4b helps to explain why.

An automobile is cruising along the highway. The relative wind deflecting off the windshield and over the roof is horizontally analogous to the downdraft. Enter a large bug. Does the unsuspecting insect follow the deflected airstream to safety or does it go splat?

The bug is incapable of changing its direction of travel so rapidly because the doomed creature has inertia. And this explains why an airplane can indeed be thrust into the arms of Mother Earth by a sufficiently powerful downdraft.

Understanding the forces responsible for the downdraft can help a pilot to select a heading that leads to safety and possibly an updraft that can expedite the return to a safer altitude. □

Figure 4a

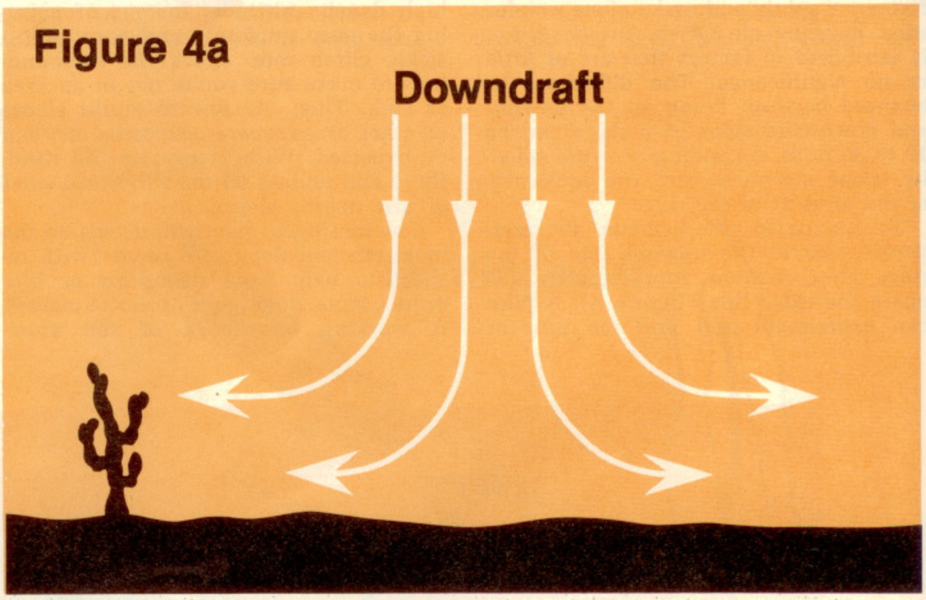


Figure 4b