THERMAL FLYING - THE HOW'S AND WHYS
By Bill Forrey

It's summer. The skies are blue and beckoning. There's a light breeze, and its 75 degrees. Your sailplanes radio system has a fresh charge, the lawn's been mowed, and you have a few hours to yourself.

What comes next? Loading the car with the flight box, the hi-start, and that big beautiful bird!

There's only one problem. It's been six months since you last flew a sailplane. You know you're in need of practice because last year's flying season ended just as youwere getting the hang of it.

As you pack the car, you envision an embarrassingly short flight in front of your old flying buddies. Did you imagine laughter? A little "friendly" ribbing aimed your way? The vision causes butterflies to bounce around inside your guts. Your nerves are on edge. You're light headed with excitement, anticipation, and a perhaps an occasional squeeze of adrenaline that makes your heart race.
"Get real," you say out loud, "Get a grip!" You know from experience that the fun you always have will outweigh everything else. So you pick your imagination up by the nape of its neck, reprimand it for its insubordination, and finish packing the car with the determination of a Chuck Yeager. A minute later you're headed toward the local glider field with mental pictures of flying into 300-foot-a-minute "hat suckers."

We've probably all had moments of irrational thought like this at one point or another in our flying careers. They come from the insecurity of inexperience. With time, they stop coming. What I'll attempt this month is to speed up the process for those fledglings out there who are interested.

We'll offer some ideas about what thermals are, what they look like, and how sailplanes react inside them. We'll discuss how to work a thermal, and then how to land. With all that information under your hat we'll make you an "old pro" in one season . . . all from your easy chair!

What Is A Thermal?

A thermal is a rising body of air which is warmer than its surrounding air. There are two main "models" (see Figure 1) which represent the physical appearance of thermals: the intermittent "bubble" or vortex ring which represents the most common form of thermals; and the "dust devil" (visible or invisible) which represents a rarer, more constant or even stationary form of thermal.

Thermals can do almost magical things to flying machines and soaring birds. Personally, I get a kick out of showing someone a thermal that has never seen or heard of the phenomenon before. Statements and questions like, "I can't hear any engine. What's making your airplane go up?" are common. Knowing what we do about soaring, we could all be medieval wizards if we could travel back in time with our model sailplanes.

How Does A Thermal Form?

Thermals are formed when cool air passes over a source of heat and is warmed by it. Warm air, of course, rises. The thermal source can be literally any large surface which is warmer than the air that surrounds it. The surface usually absorbs heat from the sun more rapidly than its surroundings and readily gives off its heat to the air.

A few of the most common thermal sources are plowed earth, dry grassy areas, man-made surfaces such as a gymnasium rooftop, or a dirt or asphalt parking lot. Even unlikely sources produce thermals. I have seen vultures thermaling over a Cal-trans Park and Ride lot here in Southern California at a shady, cool, 7:00 a.m.! The 50 or so hot engines produce enough heat to generate an early morning thermal.

Often a line of trees will generate a stream of bubbles. What happens in this case is that the trees shelter the ground on their leeward side. The cooling wind is blocked. The relatively stagnant air gets heated by the sun-drenched ground, and then it rises in periodic bubbles.

A row of trees may be solid enough to form a very efficient wind barrier. On the windward side, the breeze is forced up and over, forming wave lift on top. But I'm wandering away from the subject of thermals here. Perhaps in a future article we could cover wave and slope lift.

Thermals tend to be cyclic, coming in periodic intervals of time, often quite regular. Bubbles of boiling water make a good analogy. If you can imagine a puffing steam locomotive traveling down a track you have yet another picture of a periodic thermal.

It is hard to be dogmatic about the shape or size of thermals. Thermals can be as small as the tightest circle your glider can fly or as large as entire fields. Often during contests, one flight group can take off and every model will go up practically without respect to location. The next group will launch and the field's cycle will be between puffs. The models will be on the ground in two or three minutes.

Air is a gas. Breezes can be very turbulent and have many horizontal, vertical, or even spiral wind currents caused by obstructions. These could be houses, trees, passing trucks, local topography, etc. Turbulence can sometimes be mistaken for lift.

As shown in Figure 2, the "top view" of a thermal bubble may look like anything from a perfect doughnut shape or smooth mushroom, to the lumpy shape of a head of mutant broccoli! (Hey, stop laughing. Sometimes an analogy can be very descriptive!) Turbulence and the shape of the heat source can distort the thermal radically. The stem of the broccoli could be representative of the strong core of rising air, and the irregular outer edges the unstable, turbulent "sink air." Lift proceeds up the stem, cools, flows outward, and then sinks.

What Kills Thermals?

By contrast, any potential thermal source can be affected negatively by many factors. A stiff wind will keep the air mass moving so fast that it doesn't have time to get warm. Wind often is so turbulent that what little lift there may be is quickly mixed up with cool air and destroyed. Sometimes this lift is very hard to distinguish from just plain rough air. Usually you get suckered into making a circle with your sailplane. That's when you find out you're in sink!

Another major factor is the position of the sun. If it drops too low in the sky, it will no longer heat the surfaces likely to produce thermals. Certain dense surfaces - concrete for example - which have high thermal mass will continue to give weak lift after sunset. However, sources like these eventually die. Mornings and evenings are poor times for strong lift. Shadows can also ruin a likely thermal source. A lack of heat contrast in the surrounding area will likewise hinder strong thermal development. If you were flying over a large, dry lakebed at noon in July with no wind, you would be as likely to find thermals as snowballs!

How Do You Use Thermals?

Here we probably run into as many flying techniques as pilots. There are, however, a few widely accepted rules for thermal flying. The illustrations I've drawn show these rules of thumb. Unfortunately, the models are drawn somewhat larger than they would appear in real life in relation to the size of the thermal. Just picture them smaller and you will get the idea.

The first step is recognizing a thermal when your model encounters one. Obviously, you would expect the model to go up. True, most of the time that's what happens, but not always. Let's look at the internal structure of our thermal models, and then place a few models inside each.

Figure 3 is the classic thermal bubble or vortex ring. These are practically impossible to see due to their gentle nature at ground level. They tend to pick up no dust or paper to make their presence known. However, the soaring birds and insect hunting birds find them and often mark their presence in large numbers which in many cases actually define the outer fringes of the bubble very graphically.

In Figure 3, the model sailplanes E and A are passing over a developing bubble and through the top of the bubble respectively. This case is the most obvious. Models A and E may encounter a little sink just before they enter the thermal. They may be pushed away from the core of the thermal if they hit off center. They may even encounter a slight increase or decrease in speed if they hit head-on. However, providing they can circle centered over the core, they are soon climbing strongly.

Because the thermal bubble is cooling as it rises, the top of the thermal is rising slower and flowing outwards to make room for the heated air that is coming up from below. These two models may have trouble staying centered in the thermal. Their pilots may have to constantly re-center their birds. Each will settle down in an area near the top of the thermal that matches their sink rate (relative to the vortex). The thermal vortex will carry them upwards until it cools and loses energy.

Model B in Figure 3 will experience the strongest lift inside the thermal and soon will be up with A and E. Model B will have an easy time staying centered in the core of the thermal.

Model C will experience sink that may try to suck the model towards the core or just push it away. This model may try to bank in the direction of the core as it sinks if the outer edge is well defined. Just below this area on the outside the thermal is likely to be turbulent sink as air rushes in to fill the void created by the rising thermal.

Model D is the guy who spots a thermal and flies over to enter it, but arrives too late. His buddies' planes are rapidly going out of sight. Unfortunately, the thermal has passed through already and only a little residual "zero sink" air remains. He will need to find another ride in a different area, or if the bubble frequency is close enough, wait for the next bubble.

Figure 4 is the thermal column, or slow-motion tornado. Often called a "dust devil" or "trash mover," this thermal is frequently visible because of the insects, dust, or paper particles that get sucked up inside. Polarized sunglasses can sometimes help you see this kind of thermal. The sky has much polarized blue light. Polarized sunglasses darken this light. When this light hits the minute dust particles, it becomes a little less polarized and a little more random. The result is a lighter shade of blue in the shape of the thermal column. The necessary ingredient, of course, is dust.

Model A in Figure 4 has just hit the column head-on. Provided the pilot can center or "core" the thermal, he will have a nice, long, high, thermal ride.

Model B has just grazed the core and is experiencing a shove upwards and away from the core. This pilot needs to turn into the core, fighting the outwards shove.

Model C is outside the thermal completely. He may experience light sink air. If nobody spots the thermal for him, he may never find it. So close... yet so far away!

Model D is firmly entrenched in the core. He has it made! All he needs to do is adjust his center once in awhile, and he is on the elevator UP!

How to Center a Thermal

Many years ago, when I was first learning how to thermal, I had the help of such early LSF Level V and National Champions as Chris Adams, Terry Copeland, Rick Pearson, and Jerry Krainock. Each was a very accomplished flier at that time, and each had their own suggestions on the best way of thermaling.

One of the best rules I ever heard was: if the model rises in lift, find out how big the thermal is. This helps one determine where the core should be, i.e. halfway through the lift. Figure 5 shows how this idea works. Continue flying straight when lift is encountered. When the lift turns to sink, note how far you've come and turn around 180 degrees. Begin circling at the center.

Figure 6 shows how this is done if the thermal is entered off center. Again, see how wide the lift is. Toward the end of the area of lift you may notice the model has veered slightly to the right. This is your tip-off that the main core is to the left. Make a 180- degree turn back to the left and start circling halfway across the area of lift.

In Figure 6 the dashed line shows a right turn mostly in sink. Turn more than 180 degrees to get back to the center.

Figure 7 shows the model just grazing the outer edge of the thermal. In this case the left wingtip would rise faster than the right, pushing the model into sink immediately. Make a quick turn to the left toward the tip that came up. See how wide the core is and center it.

Figure 8 shows how to recenter if part of your circle is in sink. Note the midpoint of the circle's arc which in sink. Ninety degrees later straighten out the model and reenter the core. Wait a few seconds and start circling the same direction as before.

Where to Find Thermals

From our earlier discussion, we know what kinds of things generate thermal lift. It follows that if you go where they hang out, you'll see them, right? Very true. However, thermals don't always cooperate when you want them to, so it's best to have a backup plan.

When I fly at a new field, or a field that I have very little stick time over, I sometimes ask the regulars where the most likely hot spots are. They know, and they are generally more than happy to share their knowledge with you.

If I want a challenge, I go out and look for thermals. I find there are a couple of ways to go about this. First, I look at the sky for thermaling aircraft or birds. They've already found the lift for you.

Second, I'll look for signs at ground level for nearby thermals. Shifts of wind direction or speed can sometimes be indicators of lift nearby. These are detected by feeling, or are visible as unusual wind in nearby trees and grass. Thermal columns are like big invisible vacuum cleaner hoses. They suck in air from all sides and take it up.

Here's what to look for. There is a brief lull in the wind just before a thermal passes directly over a spot, then there is a big increase in wind just as it passes. A thermal passing by will feel like a 90-degree shift of wind, as shown in Figure 9. Please note that these are observations made from a stationary viewpoint as the lift drifts by, not from the moving wind. Third, if there are no indicators, I go where I think the likelihood of lift is high. I look for thermal generators, and then send the sailplane over to check them out.

Fourth, if I haven't a clue, I'll fly a large, crossfield zigzag pattern upwind (see Figure 10), like a sailboat tacking upwind. I find that I see the plane rise in lift much better from the side. Also, in the zigzag pattern, I never cross the same dead air twice (a big no-no!).

Finding thermals takes practice. There is no substitute for a trained eye and an experienced thumb. Give yourself time to learn! Landing the Model

Okay, so your neck is tired and you want to come down. What's next? Landing. Terra firma. The moment of truth! Will the glider re-kit itself? Will the landing be sloppy and embarrassing?

Like thermaling, there is a preferred method of approaching the landing target area. Most pilots feel comfortable with the classic rectangular pattern shown in Figure 11. This can be adjusted to suit the field conditions easily. If it's windy, the downwind leg is kept short. If the field is small, the pattern is reduced in size to suit.

If the breeze is gentle, start the pattern with about 30 seconds worth of sink time

left in your glide. Judge this by present altitude and current sink rate. Fly down wind from yourself for ten seconds and turn to your base leg. If the wind is blowing hard you can cut this time down dramatically. Fly down the base leg for five to eight seconds, depending on the wind you encountered on your downwind leg, until you are almost directly down wind from the spot. The base leg can be adjusted for altitude and speed using spoilers or flaps to assure a precise final approach. Turn up wind, allowing enough time to get back to the spot. It will take longer to come up wind than it did to go down wind.

Shooting landings over and over is the only way to get good at judging the three legs of the landing pattern.

This completes today's armchair flying talk. I hope that you found something profitable in it. Sorry I bored you if you didn't. If you have any thoughts, tips, or observations in this area, please send them in! I'll be glad to air them so that we can all benefit!

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FIG. 1 THERMAL MODELS

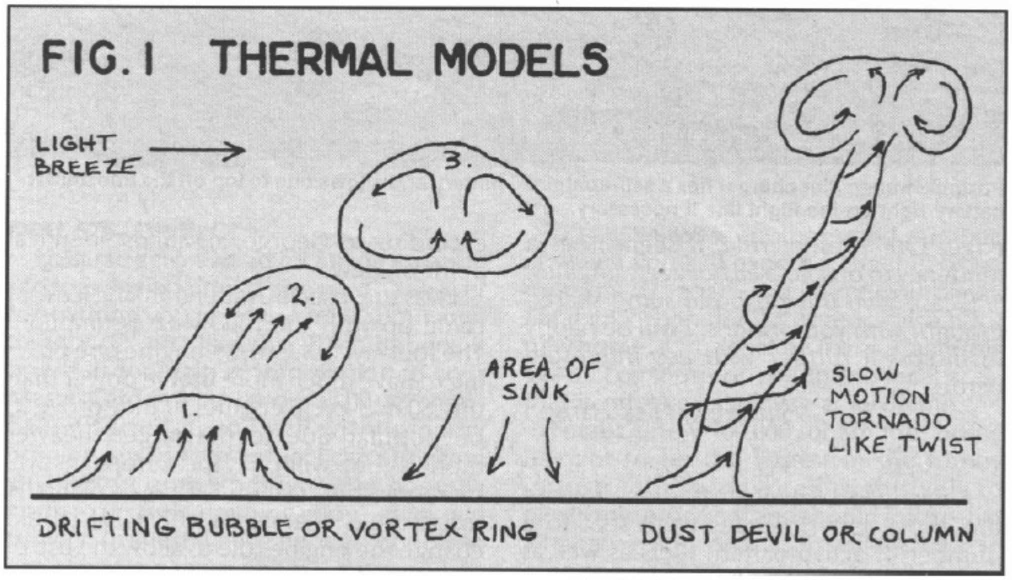


FIG. 2

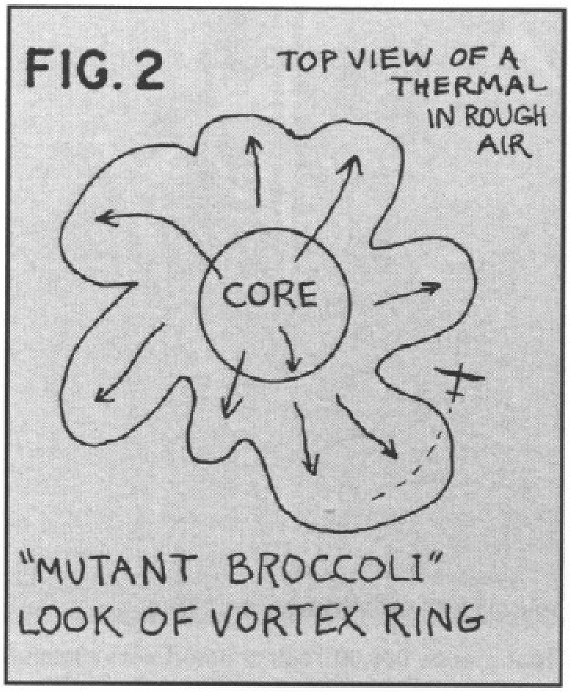
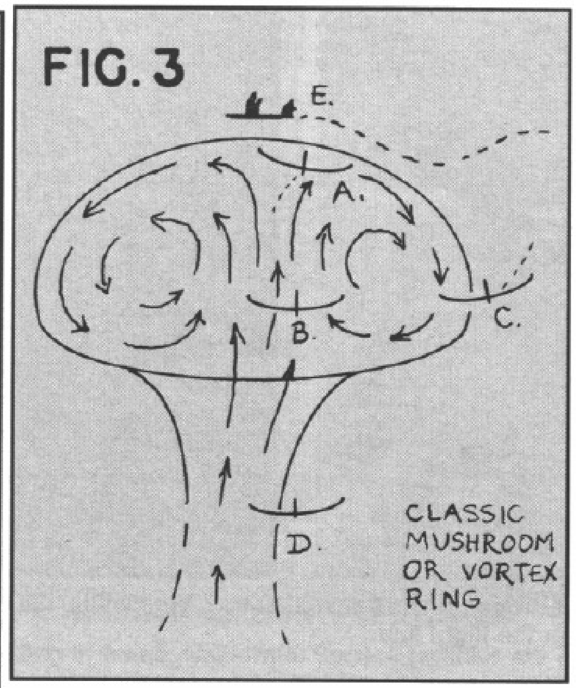


FIG. 3



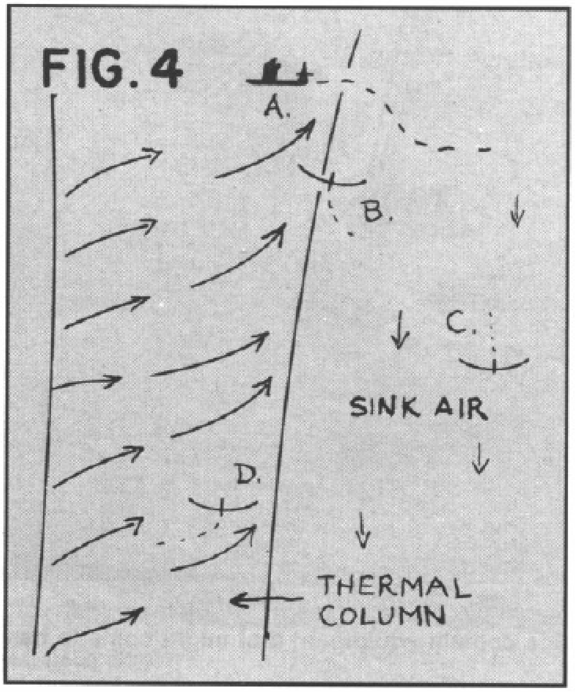


FIG. 4

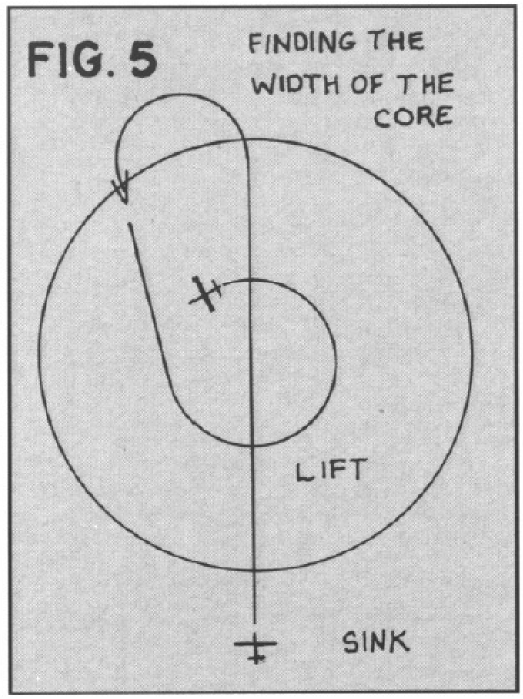


FIG. 5

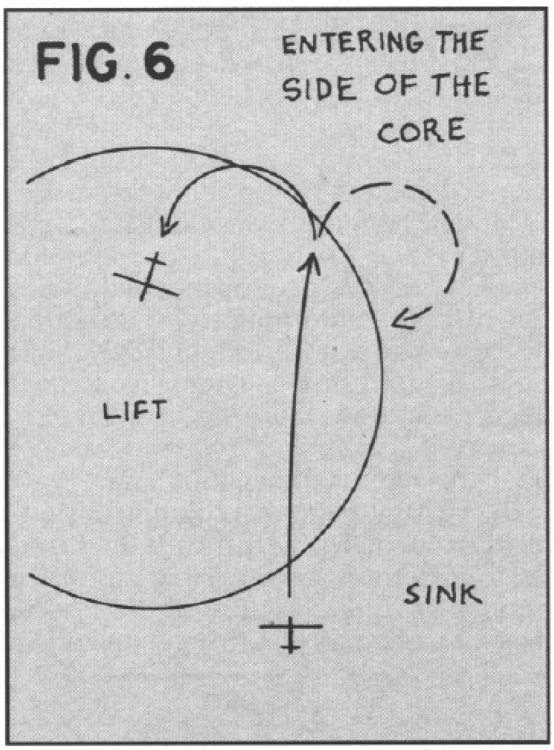


FIG. 6

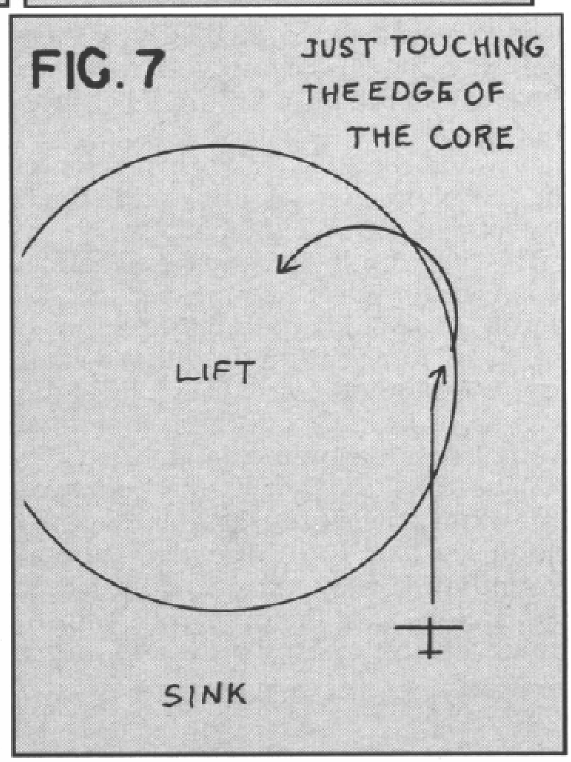


FIG. 7

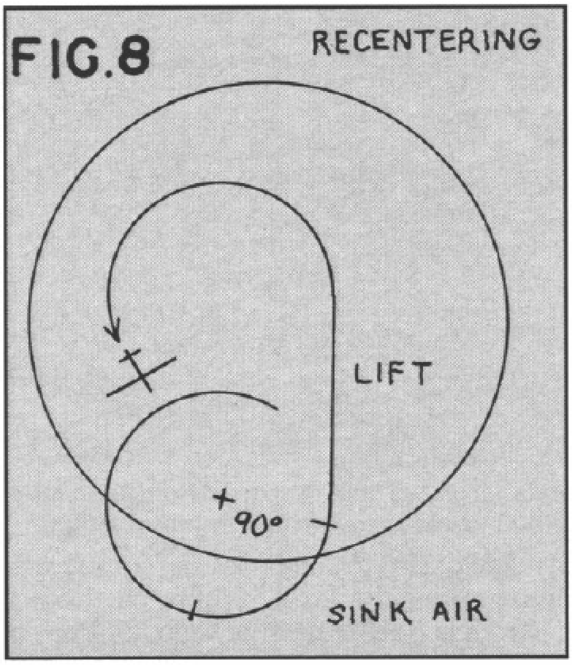


FIG.8
RECENTERING
LIFT
90°
SINK AIR

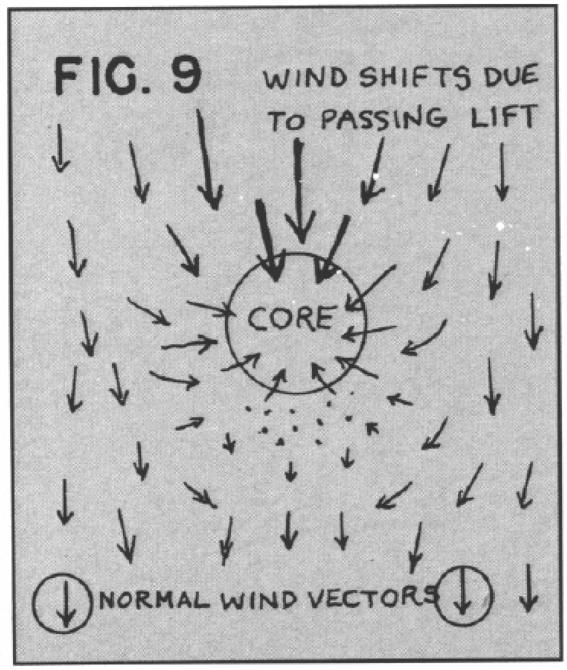


FIG. 9
WIND SHIFTS DUE TO PASSING LIFT
CORE
NORMAL WIND VECTORS

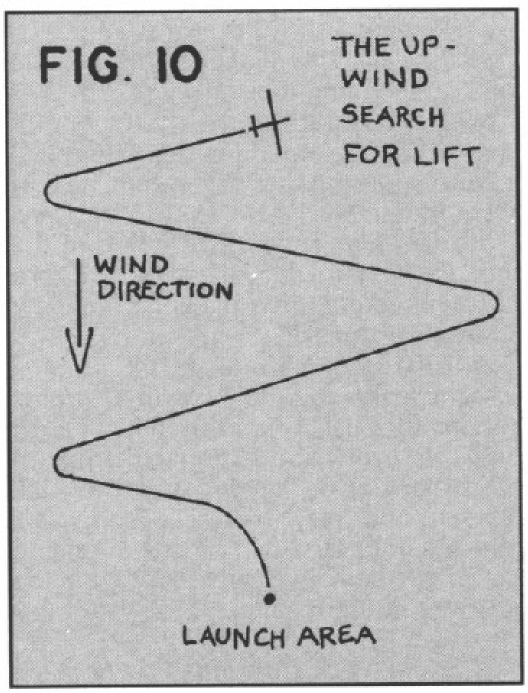


FIG. 10
THE UP-WIND SEARCH FOR LIFT
WIND DIRECTION
LAUNCH AREA

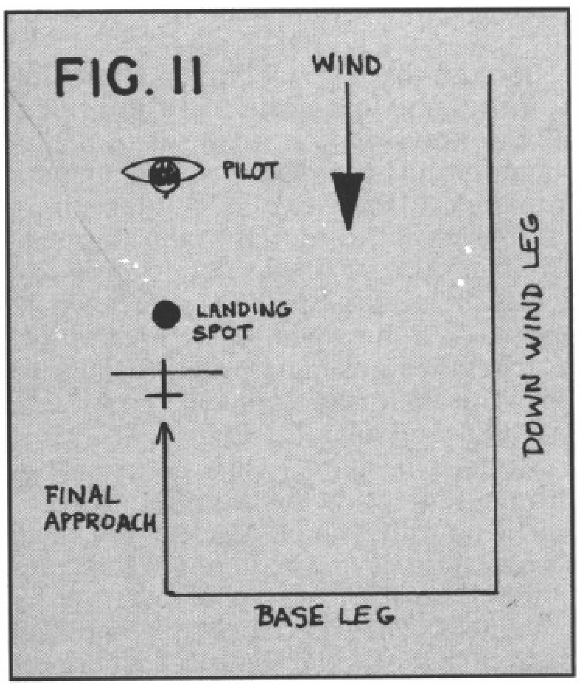


FIG. 11
WIND
PILOT
LANDING SPOT
DOWN WIND LEG
FINAL APPROACH
BASE LEG