Thinking Outside the Blocks

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PART I : Weathering Heights

One reason we like personal flying is that there are few hoops to jump through compared to other types of flying. The only legal matter we have to obey is airspace limitations. The ratings or licenses are essentially self-imposed. The result is that we are mostly an experience-based activity. Pilots learn some important information in schools, but continued learning takes place through experiment, observation, a bit of reading, scary episodes and beery discussions. There is no real control over this breadth of knowledge, and different pilots acquire different amounts of learning and skill. We often find that information, as well as misinformation, gets codified and passed along as gospel—without too much thought process being involved. We all need security in flight, so we grasp at any branch that seems to offer support, even if it turns out to be a straw.

In this series, we are going to present some of our ideas about flight with an interest in helping pilots dispel mental blocks and the confines of the concept box. We will look at weather factors and matters of flying technique and design. Hopefully, it will be a fun journey, if not educational. In general, these articles will appeal to both hang gliding and paragliding pilots, although in later parts the emphasis will be on hang gliding (sorry, rainbow crew).

This month we begin with some weather factors.

IT AIN'T NECESSARILY SO.

Ira Gershwin, who wrote the song "It Ain't Necessarily So," probably didn't know a thermal from a bean fart, but he did have an inkling of misguided misconception. Just because a lot of people *believe* something doesn't make it true. Here's a case in point: I've often heard pilots say, "It was really cold last night, and it's going to be sunny today, so there will be good thermals (or a good lapse rate or strong lift, etc.)." This idea arises from evidence that the air mass gets cooler after a cold front passes, usually resulting in good thermals because the air's lapse rate (temperature profile) is good (unstable). But after this hopeful prognosis is given, more often than not the next day *doesn't* turn out to be good for thermal production. In fact, some days are complete duds, with nary a wayward thermal gust stirring.

Here's what happens: During a high-pressure episode, the sky tends to be clear, and the night air gets cold due to the radiation of the heat. (When there are clouds, the heat is trapped, and the night air doesn't get as cool.) The result is a ground inversion, which is very stable. It is true that the next day's solar heating can dispel this ground inversion, but *high pressure systems tend to have stable air masses.* That is because the air is slowly falling over a wide area in a high-pressure system, and sinking air becomes more stable. So what's important is *not* how cold it gets at night, but what the *actual lapse rate* of the air mass is.

In mountainous areas, the cold-air-at-night phenomenon is more pronounced, because mountains trap the cold air in the valleys, thereby allowing more cold air to accumulate as it slides off the peaks. In deserts, the clear air and high transmission of heat from the dry, sandy soil allow the air to cool off dramatically (and uncomfortably). In the western regions of the US, even with powerful solar heating, thermals can be anemic in a high pressure. In the Owens Valley epic flights are accomplished during a relative low. (We talk more about this next month.)

So don't tell me that thermals are going to be great because there is good heating, and the air was very cold last night. It ain't necessarily so.

WONDERFUL WINDS

There's a flying condition we call *wonder winds.* Hang glider pilots in the late '70s came up with this name to describe a condition during which the wind picks up, and lift seems to be smooth and bulletproof over a wide area. (You won't find this term in the weather books, except those by a certain author.) Essentially, wonder winds are a widespread upwelling of lift. (Sometimes we use the term *magic air*, but this term usually refers to widespread lift with little or no wind.)

Throughout the '90s, a series of hang gliding meets in the Sequatchie Valley near Chattanooga, Tennessee, were called the East Coast Championships (the Team Challenge now takes place there every fall). Launch access is limited, so an ordered launch is necessary. And when it was a pilot's turn to go, he almost *hadta go.* There tended to be

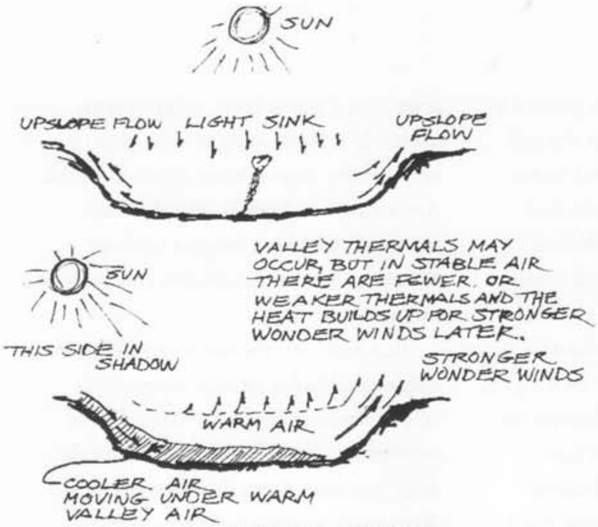

FIGURE 1 - WONDER WINDS.

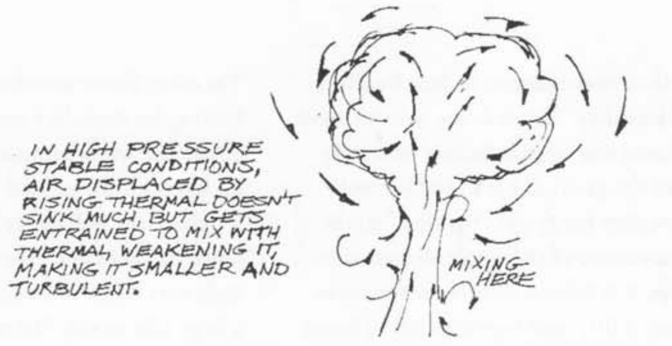

FIGURE 3 - HIGH PRESSURE THERMALS.

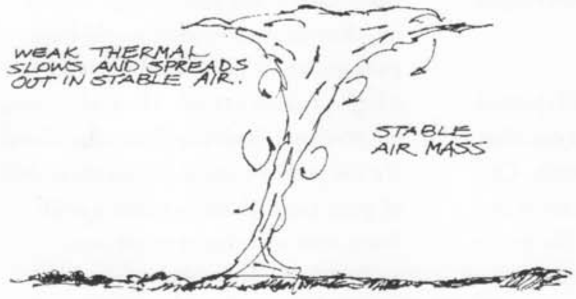

FIGURE 2 - STABLE AIR THERMALS.

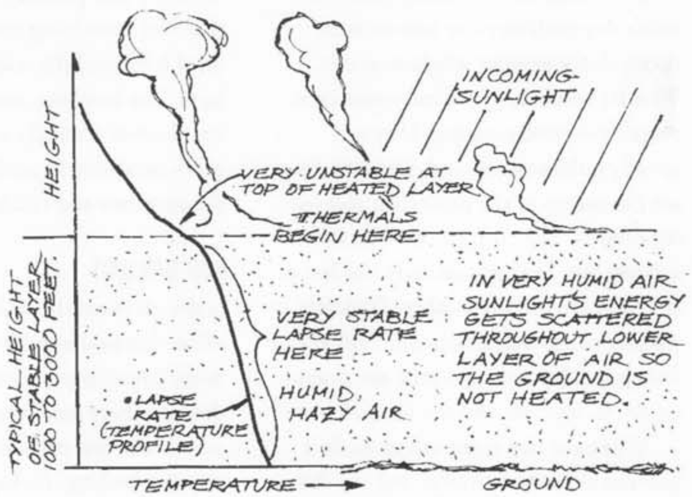

FIGURE 4 - HUMID AIR STABILITY.

many bomb-outs on weak days, but re-flights were allowed. When it got late, pilots often waited around for the wonder winds, which are common at this site. In the early days of this meet, some pilots made a habit of waiting around until late, then cruising to goal easily on the buoyant, abundant wonder-wind lift. Eventually, the organizers added a rule that required pilots to launch before a set time, so they wouldn't sit on launch all day.

But even when wonder winds were a viable option, pilots sometimes got skunked, because no one really knew how to predict them. Now we know more about wonder wind genesis and prediction.

Looking at figure 1, we see a cross section of a valley. During the day, the solar heating may send an anabatic (upslope) flow up both sides of the valley, unless the overall wind is strong enough to create a leeside downslope flow on one side. The result of evacuation of the valley by this anabatic flow is a slow subsidence (sinking in the valley). This subsidence may be strong enough to suppress thermal production, but often there still are valley thermals, especially if the valley is wide. Hwever, they may be weaker and fewer than those up along the mountainsides. As the sun progresses across the sky, one side of the mountain may eventually begin to shade in. The result is a cooling of the surface on that side, which, in turn, cools the air so it flows downhill (since it becomes denser) and flows into the valley. This cooler air pushes under the warmer air in the valley, lifts it and helps produce a steady upflow of lift—widespread anabatic flow, with light thermals interspersed within it.

Wonder winds result from a large area of the valley lifting by the undercut of the cooler air. If the valley wall has various gaps or ravines, the flow of cooler downslope air may be accelerated in the gap area; therefore, the wonder wind may be variable or suddenly come on strong. If enough cool air fills the valley, all of the overlying warm air may be lifted, and the entire valley of air may auto-convect—that is, it may get less stable, resulting in the whole mass going up as if it were one big thermal. This is the magic air condition.

Now, let's look at the prerequisite for the development of wonder winds. It helps if the site is an enclosed valley, so we get a buildup of heat in the valley. It also helps if one slope cools before the other to send cooler wind into the valley. A roughly north-south oriented valley is, thus, better than one aligned east-west. But even open stand-alone mountains can experience wonder winds. In that case, downslope cool air from the mountain itself cuts under the light, prevailing wind into the mountain, accelerating the upslope flow. The crucial condition we need, however, is the presence of a slightly stable air mass. When the air is stable, thermals are weak or non-existent, so heat builds up in the valley. Thermals are nature's most efficient way of distributing heat away from the ground, but in stable conditions they barely get "traction," so the temperature of the whole airmass rises. Thus, it is primed to turn into massive areas of lift, once it gets an initial boost from the undercutting cool air.

In conclusion, we need a somewhat stable day with weak or non-existent thermals for wonder winds to occur. Wonder winds can be weak—not even soarable—or very strong. They are usually quite smooth and, incidentally, are the source of the proverbial *glass-off* conditions. They can go up both sides of a valley but, in that case, may not last as long and are usually weaker. Typically, wonder winds begin between 5:00 and 7:00 p.m., depending on the site orientation, its altitude and the time of year.

When the day turns out to be duff without a thermal around, but the sky is blue, hold out hope for wonder winds. When you find them, rejoice—they are wonderful.

UNDER AN OVERCAST

We all know that a solid overcast of clouds is a thermal assassin (well, maybe Southern California pilots don't know this, since they've never seen an overcast). Or is it? A couple of months ago we were at a site at a time when a depressing gray-on-grey overcast covered the entire sky. Fear and loathing in three-part harmony. Well, we were there and nearly set up, so we had to fly. We did, and much to our joy, there were thermals everywhere. It was a normal thermal day, with thermal strengths more than 300 fpm at times, despite a coolness in the air.

So what's happening to create such a voodoo day? First, the airmass itself had an unstable lapse rate (see *Understanding the Sky* for details on lapse rate). It was coming from the northwest, special delivery from Canada, where they must specialize in cool summer airmasses, eh? The other factor was the warm ground's heating for days, like money in the soil bank. The warm ground created warm air layers on the ground that just had to relieve the imbalance by bubbling upward. This same process causes thermals over water when cold air crosses a large lake or sea. The reason for the overcast was the thick cool air moving in slowly and pushing up the humid air that had been lying around for days, until it formed the widespread cloud layer. The breakout messages: not every cloud cover is deadly to thermals; not every condition is predictable; exploit the surprises and relish the serendipity.

DOO-DAH DAYS

Stable days are the bane of all thermal pilots, because a stable day is one that doesn't readily produce thermals. Or does it? There are several causes of no- or low-thermal production. The first is no solar heating. Perhaps there is a total cloud cover, or the ground is covered with snow, or you're in the Yukon in January (bad timing). Second, there can be an inversion right at the ground or low enough to stop thermals from reaching launch. Finally, the entire air mass can have a stable lapse rate. This situation often occurs in high-pressure systems, since the air is gradually sinking in a high and becoming more stable.

Inversions can be caused by a number of conditions. One such condition is warm air pushing over cold air, as in the approach of a warm front. Sometimes in a weak front, the warm air doesn't push away the cooler air, but simply sits on top of it to put a lid on thermals. Another important inversion source is the very presence of thermals distributing heat up to the cloud layer. A thermal releases a lot of latent heat when it changes to cloud. When the cloud evaporates, it does so through mixing and the sun's direct heating of the cloud, so a net increase of heat occurs at the cloud level. As this process continues all day long and, often, day after day, a warm layer, or inversion, forms. It is interesting to note that in areas where thermals are dry—as in the American Southwest—the thermals top out at different heights without clouds, so inversions are less common or intense.

But don't tell me not to go flying in stable conditions, or that there won't be any thermals on those days. Stable conditions often do not stop thermals. They just slow them down or keep them smaller, with turbulent edges (classic high-pressure thermals). In the Northeast, we often fly in stable conditions. Due to the general high humidity, clear days arrive after a cold-front passage, which is followed behind by a high-pressure system. The really unstable post-cold-front day(s) are short-lived. (In the past, we could rely on three days of great thermal soaring after a cold front; now we're lucky to get one).

Imagine a day with a very stable air mass. But sunny. The sun heats the ground intensely, and a warm bubble builds up at the surface. This surface air is much warmer than air above it, so it's lighter and wants to rise. It will push up through the surrounding stable air as a thermal. Its initial buoyancy will be slowed down if the surrounding air is sinking, but it will not be stopped. In fact, thermals have such great momentum that they often buoy up past the level where they are warmer than the surrounding air.

In the case we are describing, the thermal is initially warmer and lighter than the surrounding air, so it rises. But when it reaches the level where the surrounding air is warmer, it slows and eventually stops. See figure 2. This level depends on the intensity of the heat of the surface air and the actual nature of the current lapse rate. The height of thermal rise may be a couple hundred feet or as much as a thousand feet or more. If your launch is above the height of thermal rise, you may never find a thermal to launch into; if your launch height is below the thermal tops, thermals will still be fewer, since some will typically stop lower.

As a thermal progresses in such high-pressure, stable conditions, it often becomes anemic and erodes to a smaller size. The reason high-pressure thermals tend to be smaller and often turbulent little bullets is that stability works on sinking pockets of air just as it does on rising pockets (thermals). That is, once a shot of air starts sinking on an unstable day, the surrounding air is always warmer than it is, so it has negative buoyancy—it wants to keep sinking. On a stable day, however, any pocket of air displaced downward by the rising thermal will not have a great incentive to sink, but, instead, gets entrained by the thermal, thereby mixing with it and reducing its size and rise.

Figure 3 illustrates this matter.

A few interesting observations: From my ultralight flying days, I often recognized the conditions described above. We typically fly ultralights on stable, light-wind days. (The purpose is sightseeing, not thermaling.) But often, as the day wears on, we can feel the top of thermals pushing up through the stable air. It may be smooth as baby pabulum aloft, but as one descends, one hits the lower thermal layer and has to contend with turbulence.

A very stable situation often occurs in humid areas. The hot, still days of summer evaporate so much moisture into the air that the sun barely heats the ground. The water vapor scatters the incoming sunlight, so it heats a thick layer—up to 2000 feet or more—and the lower layer becomes warmer but stable. It is typically quite still. However, at the top of this very thick, warmed layer, the temperature drops rapidly (see figure 4), so it is extremely unstable. If you can get above this heated layer, thermals are abundant. In flat areas or areas with lower mountains, towing aloft is the only way to reach the thermals. Watch out for thunderstorms when you are in humid conditions.Thunderstorms often develop in the evening or even at night, after the sun's heating is absent, for a couple of reasons: First, the thermals are autoconvecting beacause of the unstable top of the layer—they don't need the direct sun; secondly, any downslope evening flow lifts the warm surface layer and accelerates the convection at the top of the heated layer.

Finally, several flying buddies and I frequent our favorite thermal site, Hyner View, especially when the winds are light and our lower sites are not likely to be soarable. We are often there on stable or semi-stable days. I have spent more than an hour below launch scratching in weak, sparse thermals. Such practice really hones one's thermal skills. I find it rewarding to be able to work my assets off and stay up when it's almost un-stay-up-able. I don't want to fly like that every time, but, hey, in the immortal words of Shel Silverstein, "After you've been eating steak for a time, beans, beans taste fine." Variety and challenge are what jazzes us ADHDers. Don't tell me not to go flying on iffy, stable-looking days. I would miss a lot of fun flying. That's thinking outside the blocks.