Looking for a Thermal?

by Lawrence H. Conover

Here are a few tips to help you find those elusive contest winning thermals. All data is based on authentic experiments under the guidance of Dr Lippisch

From a 1954 issue of Flying Models, supplied by Joe Joseph, editor of the Windy Sock

A thermal is the rising column of air which gives life to high performance sailplanes, and. provides what is commonly known as the "luck" element, so popular in freeflight competition. But thermal-catching is more than just luck — armed with a basic knowledge of thermals you , can. make them work for you!

HOW A THERMAL IS FORMED. It is a contest day, mid-morning. To know what happens when a thermal builds up, we must start down close to the ground. A thin layer of air is being heated by contact with the ground. A small particle of air touches the surface and jumps. It's hot! It bumps a neighbor and transmits some of the heat energy. More particles get heated and start jumping.

Soon the thin layer of air has become a three-foot deep field of shimmering heat waves and tiny turbulence eddies. It warms for about twenty minutes, not moving away, for the wind velocity is low. A very unstable condition has built up. The air being heated has become lighter and less dense than the air around and above it. It wants to move upward, but cannot.

If you could see the air, you would be amazed at discovering that it is almost a living thing. It moves about like a restless animal. Small waves and wavelets, whirls and eddies, flow back and forth within the confines of the heated space. It tries to find a means of escape but the cool air all around is a good barrier.

Then suddenly it happens. A disturbance from outside. A cold air mass creeping in under the warm turbulent layer, a modeler running by, a bird flying low. Any of these and a hundred others. Immediately small vortices form from the disturbance, and quickly these miniature tornadoes rush around gathering up the warm air.

In but a few seconds they have entwined and the whole is a racing whirlpool of hot air which has energy and power. It twists upward, boring through the cool air barriers, and forms a rotating column of air, a thermal vortex.

That is the basic form. but it is only the beginning of the thermal's life cycle. As it continues on up in a whirling column, it drags along warm air from the area in which it was born. This warm air keeps spinning into the central vortex. Warm and light in the center. Cool heavier air thrown to the outer wall.

The vortex draws air in from outside as it goes up, expanding all the way. Cold air rushing in causes a downdraft where the thermal was a short time before.

The thermal reaches a ceiling when it runs into a layer of stable air. Sometimes it just dies out quietly from a lack of energy, and dissipates in the cooler strata. If conditions are right, the warm moist air condenses into a fine mist and forms a cumulus cloud.

If the cloud is to survive, it must gain energy. It feeds on warm air which comes from the ground. So as it moves across the countryside, sometimes with the vortex tail hanging, the cloud picks up the thermal currents coming up and grows.

Let's go back now to the place where the thermal started. When the hot air left, a mass of cold air flowed into the vacated space. Do you remember, feeling cool "thermal breezes'" on a hot summer day? Then you also should recall the hot gusty air as the new thermal was forming, and you can visualize the miniature tornado as the thermal column whirled upward. If it wasn't windy, the first thermal and the successive ones joined at the top to form a cloud of large proportions.

HOW A MODEL PLANE RIDES A THERMAL: So that you may understand clearly how the thermal works, let's go up to the cloud level, four thousand feet today, and follow a freeflight model into its thermal flight. Up here, it is quite cool for a hot summer day. Looking to any side, you can see the cloud base stretching to the horizon.

The flight begins far, below, and the model spirals up in a corkscrew climb. The clouds started forming about ten a.m. and were preceded by vigorous thermal activity on the ground. By flying early (between ten and eleven a.m.) your model has picked up a strong riser. This is actually the initial upward movement of a thermal.

You can note the effect of the buoyancy of the air as the model pauses tail high on the edge of the vortex. Usually the glide circle tightens as it moves into the strong part of the thermal. The greatest upward velocity is generally found in the first one thousand to two thousand feet, while the vortex is small in diameter.

Near the center you encounter the strongest lift. If you approach the outer edges of the column you get into the bumpy transition zone which separates the upcurrent from the cold air surrounding it. Many times you find strong currents working in this turbulent zone, just outside the thermal.
The model has been soaring up toward the cloud now for about seven minutes. When it flies into this soft quiet place, the modeler would soon be sorry if he were riding along. Heat gain through condensation causes the already turbulent air to become even more violent. A growing cloud is an aerial roller coaster!

It is important to know that the thermal cools at a uniform rate as it goes up. The rate is subject to special conditions at the time. When you first think about it you would expect the thermal to cool down upon contact with the colder air. If this occurred, it would never get more than a few hundred feet above it's initial burst.

This, however, does not happen when conditions are right for thermal activity. With any change of altitude there is a concurring change in temperature and density of the air. This is referred to as the lapse rate. Because of this, the thermal and the outside air cool at a uniform rate, and the thermal remains always warmer.

But, even more important, THE ONLY WAY THIS INDIVIDUAL MASS OF AIR AND ENERGY STAYS TOGETHER IS BY BEING BOUND IN THE FORM OF A WHIRLING COLUMN. A VORTEX.

HOW TO FIND THERMALS: If you learn how to look for thermals you can find them. I have walked along the ground inside a thermal vortex. I could see grass blown into a spiraling shape, feel the rushing turbulent air as it picked up leaves and dust, hear it whistle, it was so violent. Inside, the winds were 40 mph. I stopped walking. The thermal passed on down the field. No wind.

Of course most of them are not so strong and easily found. Try to find some yourself, by sensing where that restless unstable air is forming. A hot, silent summer day is best. There is a drowsy quiet as the waves and eddies form. Watch for gusty air on a calm day, thermal going up! Sudden about-face of the wind tee. Bits of leaves or paper rising or, even better, the dust devil — a vortex you can see, Watch the trees for momentary rustling of leaves as the vortex spins past. Follow the great thermal rider, the hawk. Best of all, look for the cumulus cloud, a thermal signboard.

Take note of the time and place: Midmorning 'til noon is the hot time of thermal action on the ground. Light colored dry fields, runways (black or white), beaches, sand, roads, buildings, the windward side of hills — these are the breeding grounds of thermals.

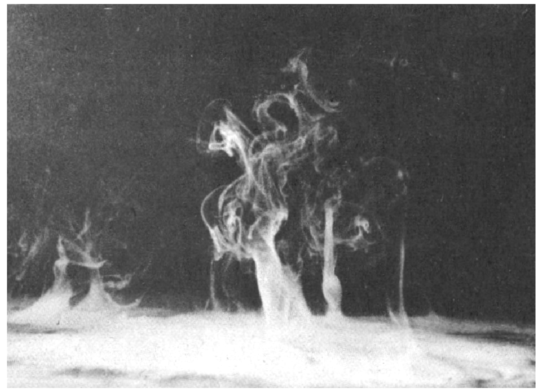
There are special places. The green, moist cornfield or the hot dry cornfield. Here the growing things act as a barrier against heat loss from a side wind. The turbulence eddies gather in an almost endless cycle and the thermals go up strong.

Certain arrangements of the terrain can trigger off upcurrents at regular intervals: One corner of a forest, a river or stream, a small rise or mound. Look sharply across the land for a shimmering reflection in the air where the thermal is hot.

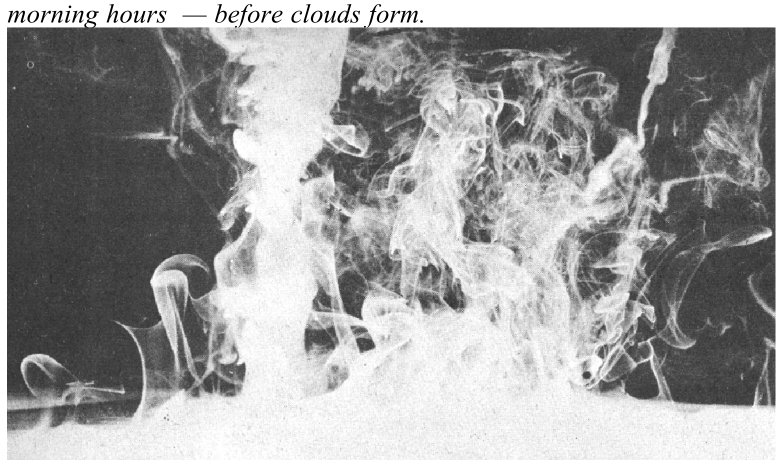
There are quiet places in the evening which, after a long day of warming, have absorbed a large among of heat. When the sun sets and the air becomes cooler, those places create risers. Then you get small lifts over the marshes, ponds, trees . . . non-daytime-thermal-fields. Also, in the evening, you find buildings, runways, roads, that produce the same

So the "dead air" conditions expected near sundown are not always dead. And the good flights made in this supposedly non-thermal environment are hard to duplicate on the contest field

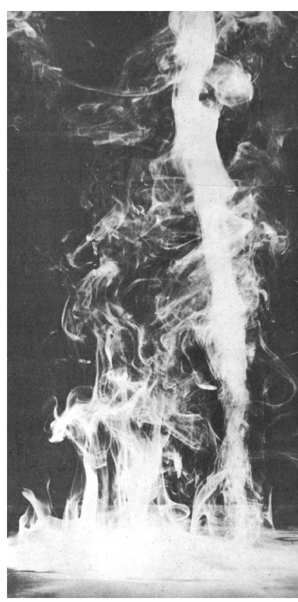
This has been the story of the thermal, an invisible tornado-vortex whose high top is a cumulus cloud. Dr. Alexander Lippisch, the original "Vortex Spinner" directed my interest in this research. From our experiments with man-made thermals came the photos showing the secrets of vortex formation.



The beginning of a vortex. Two mounds of air have formed eddies and are about to start twisting upwards. They are so close together that they will later combine into one large thermal column. This is how weak "risers" look in the morning hours — before clouds form.



Note the strong central vortex which is surrounded by warm swirling air. This tightens into a strong vortex which spirals thousands of feet up into the the air, where it cools and forms into clouds. Traveling across the countryside, it feeds on warm air rising from the ground.



In this photo you are looking at the very core of a thermal vortex - hot air -boring up through the cool air strata around it. Note the wisp-like motions at its base. These original experiments with man-made thermals were directed by the noted Dr. Alexander Lippisch