THERMALS AND FREE FLIGHT

The papers presented here have been brought together by Nick Bosdet, who has identified the need for information to enable model flyers to get started in contest free flight. They have been culled from several sources and are by several authors, to whom we are most grateful.

These re-prints give you the information you need to enjoy today's competition free flight.

First, this advice on trimming comes from 1969 World F1A Champion Elton Drew and first appeared in Aeromodeller. It was written before the advent of circle towing, but much of it still holds good today. Note that Elton favoured a left glide circle for his Lively Lady model, rather than the more usual right circle.

TRIMMING

First step should be a careful check that warps, centre of gravity and incidence are as on the plan. The only additional warping permissible is a slight, and equal, amount of washout in each tailplane tip which will probably appear naturally. Any other warps will in all probability lead to a heap of trouble - literally!

Set the auto-rudder with 1/4 in. left offset for glide and about 1/16 in. right for tow and you are ready for the first flight. *(This applies to a glider intended to circle to the left; reverse for a right turn)* Choose a calm day for initial trimming, though a little steady wind need not deter you. A hand glide reveals little, so tow up straight away with a full line length and with a 20 seconds D/T. Note any tendency to veer off at the top of the line on tow and check that the glide is safe. Forget fine glide trim at this stage, but concentrate on getting the tow straight, with adjustments to the auto-rudder only. When satisfied, adjust the glide, still using short timer settings.

First obtain a wide glide circle and trim by adjustment of the rear tailplane rest height until there is just a suggestion of a stall. Now tighten the turn slightly, and check that the stall has disappeared or is negligible.

Next tow up fast and jerk the model off the line to produce a violent stall. The nose should drop, the model wheel around tightly and recover level flight almost instantly, with two stall oscillations at the most. If stall recovery is not instantaneous remove a little tailplane incidence and/or tighten the turn still further. Do not change the tailplane incidence more than 1/16 in. from the drawing - the model must fly very close to the stall. If stall recovery from a 'jerked' launch is poor it probably indicates an overweight rear end.

Now thoroughly check out the towing. Elton regards the towline behaviour of a model as being just as important as its glide.

The tow hook position indicated should give just the slightest tendency to weave on the line. If necessary adjust to obtain this characteristic. Tow directly into a light breeze and by adjusting towing speed get the model to hang back on the line.

Change direction of tow 90 degrees to the left. The model should follow as you move at right angles to the wind direction. If satisfactory, turn round and tow crosswind to the right, and again the model should follow. Make any necessary A/R adjustments to ensure that the model can be towed cross-wind with equal facility to left or right. This means that you can 'zig-zag' when towing, very useful to delay the arrival time at the boundary fence when waiting for a thermal on a calm day! This results in a very flexible approach to contest flying. One can fly tactically, if desired, knowing that the instant stall recovery and turn will handle the most hurried and violent of releases. This characteristic is also very useful if one senses lift on the ground (i.e. from bubbles, thermistor, hairy knees, sixth sense or whatever !) and needs a very rapid tow.

The ability to follow faithfully is also obviously essential when hunting for lift on the line, particularly if towing distance or direction is limited.

In calm conditions the 'anti-fall off' system, detailed on the drawings, proves invaluable; one can tow with a slack line and negotiate obstacles confident that, within reason, the model will not slip off the line accidentally. This simple device has certainly made a large contribution to Elton's successful flying and he rates it very highly. It will not jam, but a definite tug IS required to release. Any stall induced is not detrimental if in lift, as the model will consequently whip rapidly around into its turn. In still conditions the model can, with care, be floated off smoothly.

Trimmed to the above procedure Lively Lady should possess the ability to centre itself in a thermal. Launched into the centre of a thermal the model should circle in fairly consistent, tight, albeit somewhat stally, circles until the D/T pops. If launched off centre the model finds its own way into the centre, circling wide downwind, stalling slightly as it comes into wind and wheeling around quickly. The pattern repeats itself until it has centered in the lift, when the turn will tighten and up and away she goes. It may sound far fetched but seems to work, this, Elton believes, being due to the model having insufficient rudder area to maintain a consistent turn and, indeed, without the inboard panel wash-in it would be very reluctant to turn at all. Thus when not in lift the model flies a rather long downwind leg. On encountering the turbulence of a thermal the model tends to stall - the inboard panel, due to its wash-in, drops first, and the model whips around tightly and into the thermal, or adjacent to it ready for a repeat next time into the turbulent area. The net result is a steady worming into the thermal. When right in the thermal, turbulence, acting as above, keeps it turning tightly and it stays with the lift.

The severity of the stalling action is dependant upon the conditions within the thermal. In steady lift it may be hardly noticeable, but nevertheless still seems to work. In rougher air the model really cavorts around and although the resultant pattern if not exactly elegant it is certainly effective.

The explanation may not be entirely correct but the model trimmed in this fashion certainly does exhibit an ability to work into, and stay with, thermals. On numerous occasions Elton has had models climb away only towards the end of a flight, the initial part of which has looked very doubtful. The model is apparently launched in the edge of a thermal (one has very little indication on the line as to just which part of a thermal has been encountered) and is reluctant to climb away - it may even lose height. It may appear to flirt with the lift, going straight, stalling, turning slightly, repeating the routine until, finally, the turn tightens and away she goes. Onlookers often dismiss this as luck and indeed on occasions this is probably true - one always needs a little luck ! However, we prefer to believe that the trim is responsible, or is at least assisting one's luck. Perhaps one has indeed 'boobed' and released nowhere near the thermal, but the model, with this 'thermal seeking' trim, has found its own! This is what one has been aiming for - a model that stays in a thermal if you put it there, works into the centre if launched on the edge, and finds its own lift if you miss it altogether!

This next article appeared in a National Free Flight Society Symposium Report.

HOW TO TRIM FREE FLIGHT MODELS FOR THERMALLING

by William L. Baker

We have much to learn about the design and trim of free flight duration models; not all the answers are in and not all the questions have been asked either. A question that started Interesting me a few years ago was why do some models thermal well and others not? We have all known some models that seem to make better use of light 11ft than most models. Why do some models speed up and turn tighter in lift while others slow down, or begin to stall and lose their turn adjustments? A related question is why some models fly well in smooth air but in windy, turbulent air have a marked deterioration in performance.

I have flown free flight with modest success for some years and I flew RC sailplanes for several years, too. I have arrived at some conclusions which I will now share with you. I think much testing remains to be done, and I do not present my ideas as "proven" but as hypotheses for you to test.

The free flight duration model flies in circles in its glide. The circle is caused by stabilizer tilt or by rudder deflection or by combination of the two or by some assymetry (usually twist) in the wing itself. The turning airplane has an outside (of the turn) Wing and an Inside (of the turn) wing, and there will be some difference in the airspeed over the two wings in the same manner as there is a difference in airspeed at the tip of a propeller as compared to mid-blade. If this difference is too great the machine will tighten its turn too much and a spiral dive will result. In the flying of both "real" and model sailplanes one often encounters strong lift that is so small in diameter that a very tight turn must be pulled to used it. Much "up" elevator must be used (due to Zaic's "circular air flow" effect) and considerable opposite rudder and/or aileron must be held to prevent the turn from tightening to uncontrollable limits or rolling. This crossed control technique is often used in models. Turning right with stab tilt against left rudder and/or wash-in on the right wing panel for example. We have all seen models "spin out" of a thermal (not a true spin, a spiral dive really). The hand-launched glider flown with minimal decalage is especially prone to this problem. The hand-launched glider is usually flown with some wash-in on the left main panel and left rudder: crossed controls again.

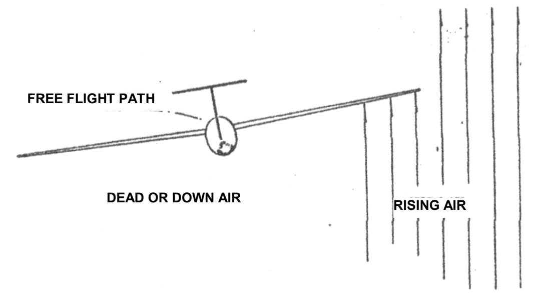
I do not fully understand why the circling model increases its airspeed upon encountering rising air, but I assume it does. Otherwise, I cannot explain why the turn usually tightens in rising air. All the turning forces such as rudder deflection, stabilizer tilt, and wing twist are airspeed dependent: more powerful with increasing speed. I think the circle tightens because the model tends to reorient itself in the air flow which is now re-vectored somewhat and the new resultant of the lift and weight vectors is greater, causing an increase in airspeed. This is the key to understanding thermal trim changes.

In 1954 and again in 1955 the World Champion Nordic flyer was Rudi Lindner. He flew with the outside wing at a slightly increased angle of attack. The model is flown in a loose circle and when it encounters lift the circle tightens. The Lindner adjustment does work but it is very dangerous in that the outside wing can develop, in a strong thermal, such excess lift as to spiral the model down as described earlier. The modern trend is to do just the opposite to Lindner's trim. There is increased angle given to the inside wing to "hold the inside wing up".. That is, to compensate for the airspeed differences between the inner and outer wings, and allowing a safer tight turn using enough rudder or stabilizer adjustment to overcome the wing twist.

At this point I would like to point out that thermal strength, (vertical velocity) is not uniform and the strength increases from the thermal's outer edge to the core. The gradient is very high. You have to get into the core to get strong lift, hence, the desirability of tight turns over wider turns which would obviously be more efficient in non-thermal air ..

The free flight model due to its tendency to tighten its turn with the increasing lift (and therefore to loosen its turn slightly in somewhat weaker lift) can find and exploit the core of a thermal in a way that is quite wonderful to behold. It is something you can really appreciate if you have flown a non-free flight soarer of any size and know how hard it is to learn to operate the controls in such a manner as to core the thermal as well as some free flight models do.

Now, if all of the turn adjustments are in one direction the model will tighten up its turn in lift which is desirable. However, if there are crossed controls as previously described it gets more complicated. The model may turn right because of its stab tilt but at increased the left rudder tab may become more effective or the wash-in on the inside main panel may, due to the increased speed, begin to overwhelm the turning effect due to the stab tilt. In other words, the rate of increase in turning force due to a change in air speed may cause an imbalance In the crossed control trim. Yet, many models with wash-in in the main inner panel do tighten their turn in a thermal quite well. The reason is that the wash-in provides more drag as well as lift with increased speed and this is also a turning force. So, wash-in can tend to open or to close glide turns in a thermal depending on whether it is the increase in lift or in drag which tips the balance that results in a changed glide circle. If your model does stall and tend to lose its turn In lift the thing to do is readjust it with somewhat less crossed control effect.

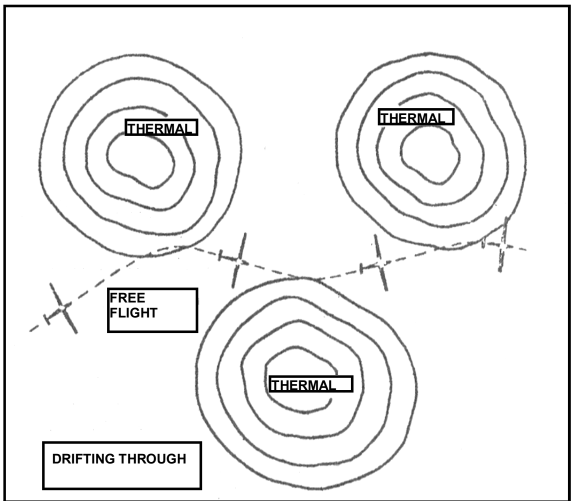


Rising air can turn an improperly trimmed model away from lift.

There is a turn adjustment I have not mentioned which is not velocity (airspeed) dependent. Asymmetrical weight distribution. If one wing tip is slightly heavier than the other the model will tend to turn toward that wing tip. The effect will not be altered by a small airspeed increase, but a vertical acceleration as provided by a thermal will tend to tighten the turn, that is, cause a rolling motion in the direction of the turn due to the inertia effect of the heavier tip. By a wonderful coincidence this helps in windy weather, thermals, or no thermals.

If you have a model that seems to fly well in "dead air" but thermals poorly or just stalls and "wallows" about awkwardly in wind, check it for the exact CG location; you may find the problem is that the wing on the outside of the turn is a bit heavy. This is easily compensated for by a bit of yaw or other trim force in smooth air. In the turbulent air of a windy day or a thermal the glide tends to open out at bad times and stalls and mushes and downdrafts get you, just when a tightened turn would put you into the lift or at least keep up the airspeed by turning out of the incipient stall caused by a gust. Check the model you have that does thermal well and goes in wind like a champ. Chances are it does have a somewhat heavier wing on the inside of the glide turn. How much weight am I talking about? Not much. About two to three grams on a 250 to 300 square inch model.

I have not experimented to see if more asymmetrical weight will increase performance still more. I doubt that it would. What is wanted is just a tendency for the inside wing to drop relative to the outside wing tip when the model encounters a vertical gust. A model with the wing perfectly balanced will fly OK but with the outer wing heavier I believe there will be a serious trim problem in turbulent air.



The pilot of a sailplane adjusts the radius of turn reacting to his rate of climb instruments, to find the center of a thermal, and will not drift through lift as shown above. The free flight model, properly trimmed, can do the same thing because it changes turn radius automatically in such a way as to work its way toward the center of lift, or the "core."

We seem to have reached an era of interest In asymmetrical wing area for outdoor duration models. Indoor models and control line models have used asymmetrical area wings for some time. I believe that any model which spends its entire flight turning in one direction can with profit use a wing that is asymmetrical in area. The article by M. Buckmaster in the 1979 NFFS International Symposium Report argues for the efficiency obtained by increasing the area of the inside of the turn wing. The idea is to compensate for the slower airspeed on the inside wing and allow the entire wing to operate at its best L/D angle. I think this approach does promise more "dead air" efficiency than wash-in on the inside wing. What effect this has on thermalling behaviour I cannot say but it cannot be all bad as the 1979 World Wakefield winner Ben Itzhak (see the 1979 NFFS International Plan Book) uses an asymmetrical area wing.

The technique advocated by Buckmaster and used by Ben Itzhak is to use less taper on the big wing; the span and root chords are the same on both wings but chord at the polyhedral break and/or the tip chord is greater. I assume this would mean the bigger inside wing is heavier than the outside wing. I would like to know if Ben Itzhak added weight to his small wing or left the larger (and I assume heavier wing) unbalanced. I suspect the latter and believe this is the adjustment we will be seeing more of, as I think the increased area on the inside wing will be more predictable than wash-in in its effect on thermal flying behaviour, and it does avoid the inefficiency of having part of the wing fly at a higher than optimum angle of attack. But, would a larger area wing on the outside be a safer version of Lindner's adjustment?

If I shift the center of gravity "inside," haven't I made, in effect, the outside wing larger? I know the asymmetrical weight idea works but what is the best combination of asymmetrical weight and area? What are the unasked questions?

The following article by Swedish F1A flyer Hansheiri Thomann appeared in the April 1960 Aeromodeller. This was long before the advent of circle towing and the prohibition on towing with the winch attached. Nonetheless his observations on thermal detection are as valid today as they were then.

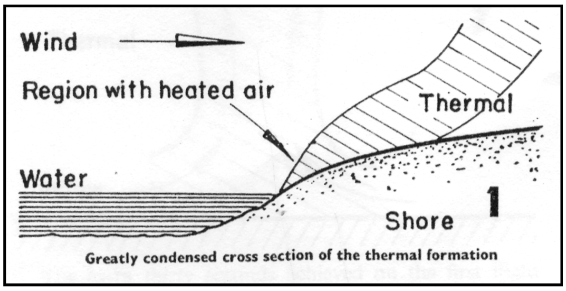
THERMAL HUNTING

by Hansheiri Thomann

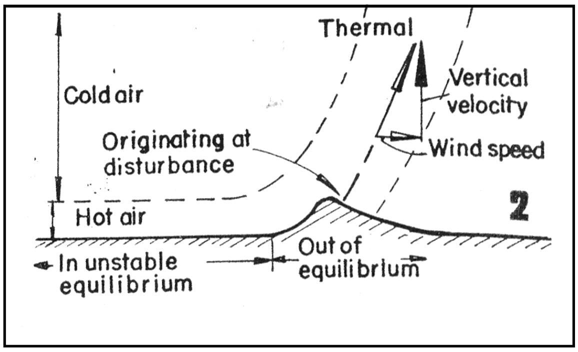
From time to time Aeromodeller has published articles concerning the improvement of glider flight and performance; here is another, containing details of thermal location over all forms of terrain, and in a variety of weather conditions encountered in most modelling countries. The last paragraph deals with general hints on glider flying with regard to towing.

One cannot predict exactly the time and place that a thermal can be expected to form, but by study of the particular flying area, one can obtain some idea of thermal location. On clear days the ground is heated by the sun; some of the energy is reflected away, some is used to evaporate water, some is conducted into the soil, and what interests us, the remainder that is transferred to the air above the ground. To predict air temperatures, this complicated energy balance must be solved. For our purpose, it is enough to know that most heat is transferred to the air in regions over the warmest surfaces.

Runways, houses and sand get warmer in the sun than such as grass, trees and water. Although the first mentioned areas are hottest, and the air above is in a similar condition, this does not necessarily mean that thermals are to be found only in these areas, as can be seen from Fig. 1. The hot air rising from the seashore gradually deepens as it is blown inland, so extending the thermal area for some distance from the point of origin. Exactly the same happens at an airfield, downwind end, over a runway or dry grass; here also as with the seashore in Fig. 1, thermals are more abundant in the downwind part of a hot spot.

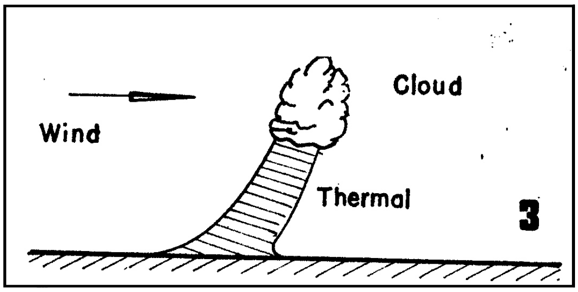


A flat layer of hot air under a layer of cold air is in equilibrium. This equilibrium can be disturbed by a ridge, a hedge, or even a row of spectators. The resultant break, Fig. 2, allows hot air to rise, forming a thermal. A thermal will not be found directly above the obstruction, whatever it may be. One has to allow for wind speed and vertical velocity of the thermal (1-10 ft./sec.); therefore the thermal is generally to be found behind the ridge, etc.

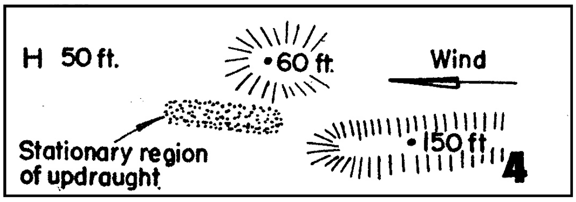


A flat field will also produce thermals, because of the inability of the so-called unstable equilibrium of the cold/hot air layers to exist for any length of time. However, the chances of finding a thermal are better behind an obstruction, as previously mentioned. In windy weather these generalisations rarely apply.

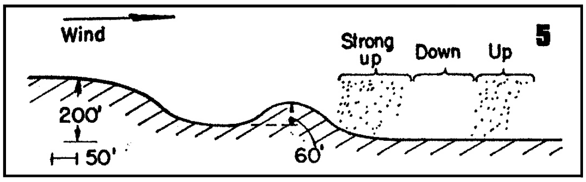
If the cloudbase is low, thermals depend more on the clouds than on the ground. Dark clouds usually contain thermals, but remember that seemingly dark clouds may actually be light, in the shadow of dark clouds, so the rule may not apply. Do not expect thermals directly beneath a cloud; the lower layers move more slowly so that the thermal lags behind, having a tilted appearance, Fig. 3, governed by wind speed. In average weather a mixture of ground and cloud effect prevails, making prediction difficult.



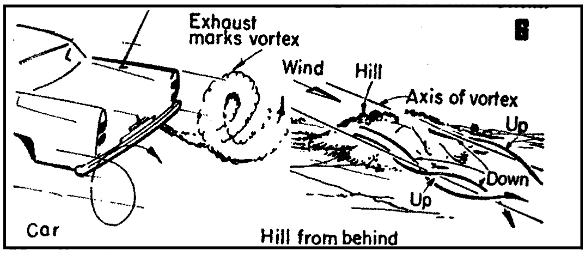
Windy weather with little sun and a high cloud base produces a third possibility for thermal location. Stationary regions can exist behind hills and forests, with up or down draughts. The writer's flying field in Stockholm, Fig. 4, about three-quarters of a mile in diameter, has often provided a stationary region created by a certain wind direction, with sufficient updraught to give an extra thirty seconds duration to a flight.



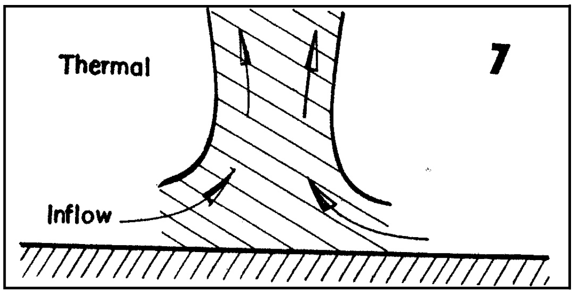
This situation has remained unchanged for several hours. These updraughts are of course, not pure thermals, as has been deduced by their existence after sunset. With another wind direction at the writer's flying field an interesting occurrence was experienced, but producing inferior flights. Model was launched and the well-known "up", "down", then strong and steady "up" were felt on the line always at the same point on the field. After release, the model completed two minutes glide. On one day the two minute flight was repeated 20 times. These flights took place behind a fairly shallow hill, Fig. 5, with a small ridge, behind this. It is not yet known if waves can be expected on so small a scale, though the previous observations suggest that waves existed. Individual experience of wave flying will probably end in disappointment, as the model will drift through the stationary upcurrent. Also on the line, waves will tempt you to release at the wrong moment, as happened with the writer's last mentioned flights.



The extra thirty seconds achieved on the first flight example were probably due to standing vortices. An example of these can be seen around the exhaust pipe of a moving car, Fig. 6. From these observations, it seems logical that a similar phenomenon could occur behind a hill that is subject to moving air. As these vortices lie apparently in the wind direction, and are fairly long, they can be used to advantage.



Having decided on what part of the flying field conditions appear most suitable, one still has the problem of when to launch. Fig. 7 illustrates how, in a typical thermal, air is drawn to the centre, on the lowest level. If the thermal is moving towards the flier, this inflow appears to reduce the wind speed. At the moment the thermal is directly above, wind speed increases higher than normal, then gradually decreasing. So it would seem that the first puffs after a period of fairly calm air are the signal to start towing. In practice there are many velocity fluctuations in the air, even without thermals, so that it is difficult to detect the real thermal especially in high wind with weak thermals. However, the Finns demonstrated at Bourg-Leopold that one can increase chances of finding a thermal quite substantially by this method.

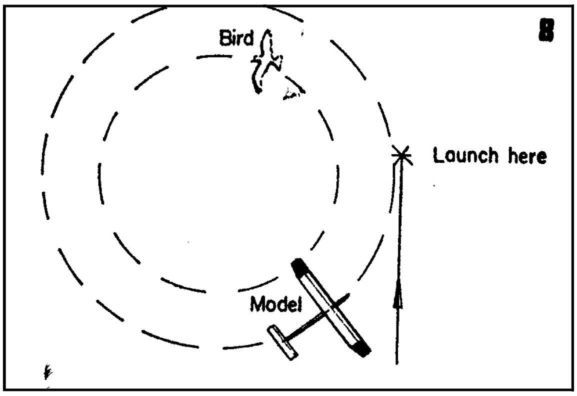


In a contest the flight of the person before you can help considerably, the singing of his line, dihedral of his wings, and running speed can mark a thermal. In strong winds you cannot afford to wait until his model has climbed, otherwise you will be too late. Other points to watch for are birds, particularly swallows, for even they make use of thermals.

Now knowing the time and place to fly, one still has the actual launch to perform. A pull on the line is always felt when the model is about 60 degrees above horizontal.

Usually this is not a thermal. Then one feels a further pull and the model starts climbing overhead. It is best to wait four to five seconds, or the model will immediately return to the downdraught you probably towed through. Never lose hope though; the big thermal is always behind the big downdraught.

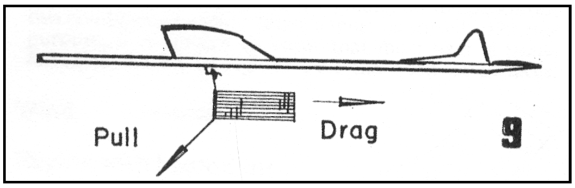
Observing all these rules, etc., it is still easy to release, the model for a poor flight. One may see a circling bird which has obviously found a thermal. The model should be launched to fly just outside the bird's circle Fig. 8. An example of how easy it is to forget this rule was given at Bourg-Leopold last year, when a perfect score was spoilt by one person. This is so easy, simply because once one is running and towing, there is no time to stop and think! Therefore the reserve model should always turn in the same direction as the one usually flown.



When does one have enough pull on the line to hope for a max.? People have been seen running for some distances looking for thermals, on a cold day, when strong thermals simply were not there. It is best not to be afraid of launching the model in a slight thermal. The writer dislikes strong thermals because of the greater chance of the model being pushed out. Also, downdraughts in the vicinity of such thermals, are similarly strong, so that one may end up with a flight of only 60 seconds duration. This is especially true with thermals forming over a runway, where, one will remember, they can be quite strong. Remember also, that every model is gradually pushed out of a thermal, as the wing that is nearer the centre always obtains more lift. Every sailplane pilot will confirm this.

Further suggestions for getting the most from a model are, firstly to do with actual towing. Train yourself by launching and paying out the line "solo" every time.

Another point, in competitions one tends to forget about breathing when things become critical. This sounds ridiculous, but it does happen. Accustom oneself to breathing regularly when running, and towing range will be increased enormously (Gerry Ritz runs a mile a day to keep in training!). Next comes the winch, which, if heavy wil1 not allow the pull of a model to be felt fully, so it is best in such cases to hold the line with one hand. The flag on the line is another point to watch. As the drag of the pennant helps release the model, Fig. 9, changing or excessive dampness of the material may produce an unexpected premature release. So we must angle the towhook Fig. 10. The writer finds that an upward bend of 20 degrees prevents pre-release if model should sink suddenly. The positioning of the hook has been amply dealt with in the December Aeromodeller, "Art of Towing" article by Canadian, Tam Thompson. To this, one must add the need for wings that flex equally under towing conditions.



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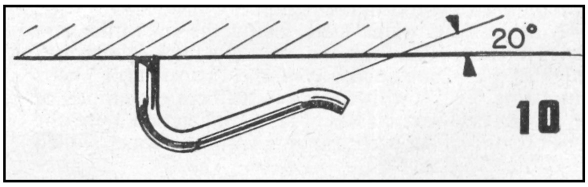

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Addition of a clockwork timer to the model is certainly worth the trouble. In a comp. the model can be launched any time without having to light a fuse. One just waits with the model on the line until the right thermal comes along, the timing of three minutes starting from the moment of

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Like the previous article, Jim Baguley's short piece on thermal detection appeared in Aeromodeller magazine in 1964 before circle towing became widespread., so its advice should be taken in context.

THERMAL HUNTING

by Jim Baguley

In Great Britain thermal hunting is still in its infancy. Most people know when they have hooked a thermal but few can be reasonably certain of keeping the model in the area of rising air.

If the model is adjusted on the towline so it will not go "to the top" and achieve the full 164 ft. height in calm weather, any small thermal will provide enough lift to give easy recognition of its strength.

If you know your model well, you will sometimes notice that it overtakes you or it is pulling slightly over to one side when at the top of the tow. Both these characteristics are easily recognisable as thermal indicators.

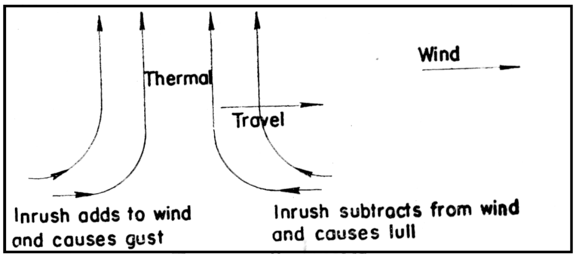
In windy conditions it is less easy to make such distinction, but the same evidence is still applicable and the model will try to go straight overhead even if not accompanied by excessive line tension. If the model is in a downdraught it will tend to lag back on the line. Any line tension above normal will have been caused by gusts.

The author finds he can measure line tension better by holding the winch in one hand and line in the other. Some people use lightweight winches, or completely detach the line. ***(NB. Towing with the line attached to the winch is now prohibited for safety reasons. Doing so may invalidate your BMFA insurance.)*** Starting with a 100 ft. of line, pay the line out as the model goes up and maintain the "feel" by using the other hand on the line. As thermals usually give a persistent pull, with down draughts located before and after them, it is quite easy to distinguish (with practise) the thermal from a gust. To help thermal recognition, always try to take the model up slowly. Long tow hooks are an advantage, except in windy weather when they make release of the line more difficult. In such a case try pulling the model down and then flicking the line up, if you have a good strong wing and ample stall recovery. Some people advise fitting light tissue streamers to the end of the line, so when the thermal comes by, they stand up vertically as a visual indicator.

The author confesses he does not know a sure method of missing the downdraught and keeping in the thermal. Various ideas have been put forward, one being that the greater vertical speed at the centre of the thermal tends to push the model out. The model should move downwind at the same speed as the thermal. The strongest thermals may not always be the best as they could push the model into downdraught. Usually thermals are held to improve duration for long enough, so an extra strong thermal, whilst being good insurance, could lose the model, if one only requires an extra 30 seconds on still air average time to get a max. Usually if the model is "floated" off the line into its natural turn it will tighten up in the thermal. Should a violent stall occur through sudden release with excess line tension the model tends to go into a turn quickly and this can be the best method of release.

Many ideas have been forwarded on how to find thermals. The author uses a model which will hold line tension until the thermal comes along. A clockwork timer helps as one can wait as long as one likes without having a vast length of dethermaliser fuse or any fears of early d/t action. (See Aeromodeller January 1963 and April 1962 for systems). In best conditions one can even stand still and wait for a thermal, but in calm one runs out of upwind ground space and in strong wind one runs out of downwind space!

A good approach is to fly before the contest and endeavour to locate regular thermals. Two other dodges are, to wait downwind of the other flyer with the line out and tow off when he obviously catches a thermal or, to wait for a slight lull in the wind and rise in temperature which shows the approach of a thermal. This can be detected by exposed arms, or cheeks of the face, especially on a cold day. There are, of course, also "thermal indicators" using thermistors to indicate a rise in local air temperature.



THERMAL SYMPTOMS

(a) Temperature rise accompanied by lull in wind and followed by gradual increase in wind speed caused by an inrush at the base of the thermal.

(b) The obvious signs of a bird or model already in a thermal.

(c) Timing the thermal pulse if the conditions and terrain are sufficiently consistent.

(d) Sudden appearance of the sun - (debatable)

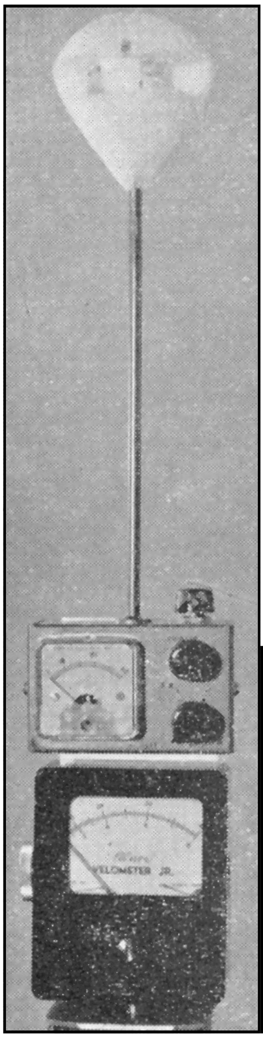
(e) Changing cloud formation (difficult to discern).

(f) Leeward of an obstruction in low wind conditions, caused by the break up of equilibrium of hot air under cold at local point.

(g) Rising slope in wind giving rise to a standing thermal followed at the downward side by downdraught.

(h) Slow warming surfaces like water. woods, grass, etc., lose heat later in the day, giving thermals.

(j) Runways, buildings. etc., cause thermals at their junctions with the above during the day.



Device at left is the very latest in transistor amplified thermistor temperature change detectors, otherwise known as “Neddy boxes" or Thermal Snifters. It is mounted over a wind strength meter. which in turn is on a tall camera tripod. Scientific approach to thermal hunting needs good team work and technique.

THE ELEVATED STREAMER AS A THERMAL AIR CURRENT DETECTOR

by Ralph Vescera

An elevated streamer Is a useful device to determine vertical movement of the immediate atmosphere. The advantages for this type of thermal detection: low cost (approxlmately $10), slmplicity, and ease of relocation upwind in high winds for advance thermal warning. Disadvantages are: the results have not 'matched the "piggybacking" method of thermal detection, and several hours practice are needed In order to “read" the streamer more proficiently for all types of weather conditions.

The apparatus (Figure 1) consists of an elevated pole with a streamer attached to the top, and a 3/8-in.dlameter steel rod clamped to the bottom for ground support. Collalpsible fiberglass. surfing poles, screw-apart bamboo fishing poles, interlocking 5 ft TV antenna sections, or combinations of these, con be used for a pole. The streamer mounting height should be at a minimum of 20 ft elevation.

Streamers are made from 1 1./2 in wide viscose rayon material marketed for making artificial flowers. It Is non-porous, and has a density of 0.9 grams/sq ft. The material casts 29 cents; for a 24 yd length, and is sold under the trademark of "Strawtex." Several working lengths can be mode up ranging from 12 ft for calm conditions to 35 ft for strong 20+ mph winds.

Other less desi.rable streamer materials are Saran Wrap (2.1 grams/sq ft), .silk (1.4), Super MonoKote (6.0), Japanese tissue (1.3) and condenser paper (0.1).

A thermal air current is a rising column or bubble of air slightly warmer than the surrounding atmosphere and carried along at wind velocity over the landscape. These thermals are usually 20 to 100ft In diameter at 20ft elevation and expand significantly with altitude. Correct launching time of an endurance model aircraft into a thermal becomes very important as for example, a 50ft diameter thermal travelling at a wind velocity of 12 mph can pass the launching site In 3 seconds.

0bservers will see the following streamer actlon (Figure D) in the presence of a large strong thermal in near calm conditions:

A. There will be a lowering of the wind velocity and the streamer tip will drop. Air surrounding the perimeter of the thermal tends to be engulfed. This action accounts for the lowering wind velocity preceding the thermal (Figure II-A).

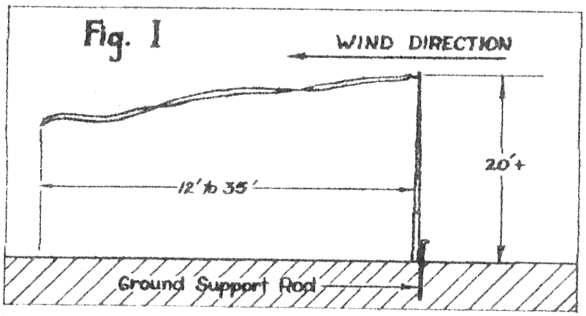


Fig. I

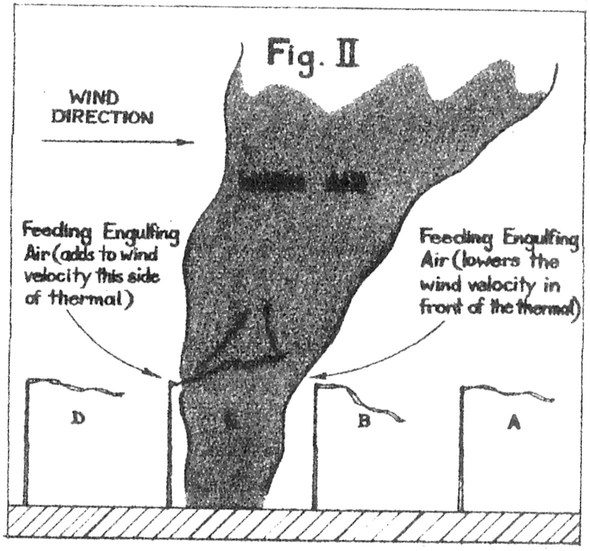


Fig. II

B. The streamer tip will drop more due to the increased engulfing effect as the thermal approaches (Figure II-B), and the compass direction of the streamer will change slightly (effect caused by the thermal center passing to the side of the streamer).

C. Warmer air of the passing thermal will raise the streamer (Figure II-C).

D. Engulfing air following the thermal can be physically felt, and the streamer tip will drop (Figure II-D).

This action becomes less apparent as the wind velocity increases, and thermal prediction becomes more dependent on the visual skill of the observer. The streamer rise described in Figure II-C, for example, can reach 20 degrees above the horizon with a strong thermal in a near calm, to a minute movement with a weak thermal in high winds.

The streamer indicates vertical air motion to a lesser degree between major passing thermals. This helps to explain why average early morning or late evening flight durations are difficult to duplicate during mid-day flying sessions.

Practice during mid-day hours with proven adjusted models is the fastest way to learn the streamer-reading art. The best model types for practice are hand-launch glider or rubber-powered models held with the motor wound. The launch release time is critical, and these two types can be released at the precise instant the streamer elevates.

Gas power and towline models are less adaptable to this system owing to the added time-delaying elements of engine starting or glider towing. Far more lead time, the streamer must be moved upwind.

Thermal detection theory is In its infancy and is bound to gain In popularity and reliability as more facts become evident. It is hoped this article adds to the knowledge.

The author wishes to give his thanks and much of the credit to Al Bennett for his help and initial development of this system. The fine art work was ably done by Dave Rounsaville.

The next piece appears, surprisingly, on the F4B Scale Magic website, and is reproduced here with the permission of website owner Mike Chapman.

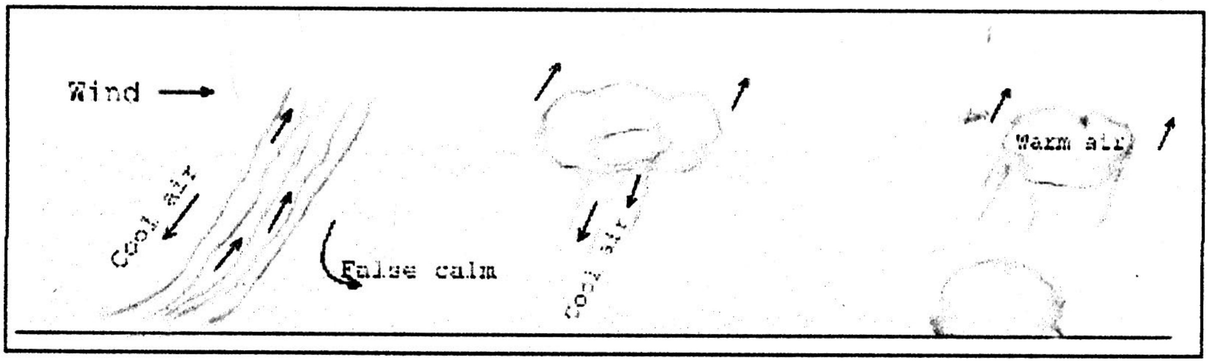
DETECTING THERMALS—OR HOW TO TROUNCE THE OPPOSITION

The first objective of any model flier is to have a model that flies well; once the model is trimmed for perfect flight the next objective is duration.

If you are flying on a local park you won't want the model to go too high or too far, but competition HLG fliers strive to achieve at least one minute duration - a 'Max' - for each and every flight (hardly ever achieved), so how do they do that?

Answer: By 'picking lift' - launching into thermals.

Thermals are very elusive, they are visible to all and sundry as we casually lean back in our folding chairs, but as soon as you venture forward for a competition flight with model in hand, they will collapse before you like soap bubbles popped by a fickle finger!



A thermal is warm rising air which (hopefully) will carry your model to a great height. There has always been some debate as to the actual shape of thermals. Thermals are said to be either columns of warm rising air, doughnut shaped bubbles and some fliers perceive them to be large bubbles of warm air which form at ground level, then break away to float skywards. It may be that thermals are large columns of warm air with a cool (downward flowing) core. Centring on a thermal is a common phenomenon; if a free-flight model centres on a thermal the result is a downward almost vertical spiral which is often terminal!

Knowledge that recently came to my notice (2003) :- Thermals spiral upwards in a clockwise direction when viewed from beneath (Northern Hemisphere).

Whatever shape thermals are - you will want your glider to be in one! There are many variables that are involved in producing thermals, i.e. air pressure, cloud formations, sun intensity, wind strength, the surrounding terrain, the list goes on !

What the surrounding countryside looks like and the amount of thermal activity it may or may not generate is not something that the would-be 'maxer' should trouble themselves with. All competitors on the day will experience the same amount of thermal activity. What we need to be able to do is to 'pick the lift' as and when it arrives at our launch point. Picking or spotting the lift will give us distinct advantages over those fliers who have no knowledge of detecting thermals and launch as and when they have the urge!

How do we do go about finding the lift? The first and obvious way is to stand next to a competitor of known pedigree and launch at the same moment as he/she does (commonly known as piggy-backing). I don't recommend that method. The flier you are watching is sure to be aware of your strategy and may try to lure you to launch into 'sink' - definitely not recommended.

I must point out that thermal picking is not an exact science and many an experienced flier has been seen with head in hands as his models wallows slowly earthwards in a patch of 'sink'. Even experienced fliers get it wrong from time to time.

We will assume for the sake of argument that thermals are columns of rising air. As this column of warm air rises, cooler air will precede it and cool air will rush in to fill the space previously occupied by the rising warm air.

There are strong thermals, weak thermals and patches of air that give the appearance of thermals but collapse moments after launch. We can't see thermals, so we need some means of detecting them and avoiding the down drafts.

BUBBLES

"Know your enemy" someone once said. Arm yourself with two or three tubs of children's bubbles - go to a lonely field and conduct some experiments. Stand in an exposed position and feel the changes of air temperature on your face as the wind passes over you. If the wind speed increases, wait, strong wind very rarely brings useful lift, wait for a lull and feel for a rise in the air temperature. When you think the air is warmer, release some bubbles, if they begin to float upwards they are in 'lift'. If they float along withQut gaining height or fall, then you were either too early or too late when you released the bubbles. Keep practicing until you feel confident you are able to sense the warm rising air and release your bubbles into it.

Disadvantages with bubbles :-

1) After you release the bubbles any signs of a thermal will now be downwind of your position.

2) You will have soap on your hands.

3) You will have to place the bubbles in a safe place before you can pick up your glider. By now the thermal will be well downwind of your position.

To overcome these disadvantages you could place the tub of bubbles on top of a long pole, a small fan is required to blow air through the plastic loop to produce a stream of bubbles - a helper is also required to take the pole upwind and operate the plastic loop.

POLES AND STREAMERS

HLG fliers need to be independent of devices. For this reason the pole and streamer technique has been developed and used almost without exception in the UK.

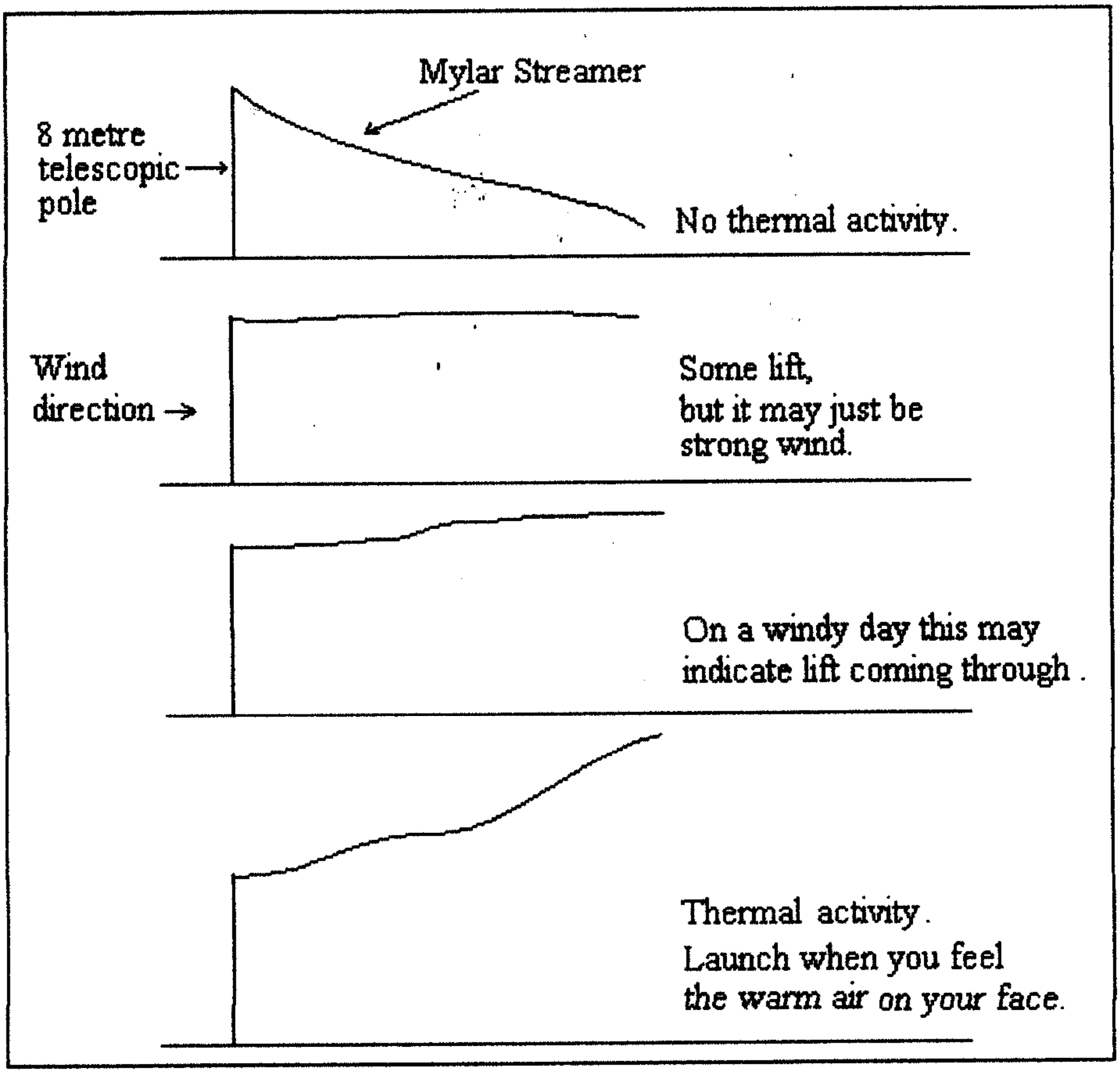
An eight metre telescopic fibreglass fishing pole is used to hoist a Mylar streamer into the wind; the pole is then fixed so that it can't fall over. The streamer length can be anything from 50 to 100 feet long and is approximately 10 mm wide. The streamer will float in the air stream and respond to warmer or cooler air by rising and falling, giving the 'perfect' visual indication of thermal activity!

Now dear reader, I am assuming that you have just run out of the house and have bought, begged or borrowed an eight metre telescopic pole and Mylar streamer!

At your local flying site erect the pole and streamer at least 60-100 yards upwind of your chosen launch position and watch the behaviour of the streamer as it rises and falls, combine that with the knowledge you gained from using bubbles (feeling the warm air on your face) and attempt to launch into lift. Chances are that you won't have immediate success; you probably launched into a down draft. The reason (in my experience) is that thermals do not rise straight up, they come along in inclined columns. The size and shape of these columns depends on wind speed, cloud formations and the strength of the sun. You alone will have to decide at what moment you are going to launch; wait for the warm air to reach your position. Remember that the streamer is only an indicato; you must continue to 'feel' for the warm air. Launch too soon and your glider will be pushed down in front of the lift, launch too late and your glider will wallow in the down draft.

STRONG ARM TACTICS

The strength of your throwing arm and type of launch pattern your model follows will also determine the moment of launch that is correct for



you. If your glider has a vertical climb with a roll-off the top then launch in the centre of the thermal. if the glider has a right/right launch pattern. position yourself to the left of the pole so that as the glider finishes its transition to level flight in the centre of the lift.

Now watch the streamer again. It will rise and fall as the warm air passes; it will also rise and fall as the wind strength increases or decreases, so can we rely entirely on a rising streamer to show thermal activity ?

Yes we can. because it is generally accepted that a combination of a drop in the wind speed. a rise in temperature and a rising (upwardly fluttering) streamer indicate a strong thermal - wait for that combination and LAUNCH! Be aware that it also possible to launch to the side of any lift that comes through; your position relative to your pole is most important. A row of three upwind streamers can indicate three very different situations.

SWIRLING AIR

Do not be fooled by swirling air. if the streamer changes direction by 180 degrees and indicates strong lift by fluttering at a steep angle - ignore it, in my experience it will collapse moments later. wait for the streamer to return to the prevailing wind direction then launch.

This swirling air phenomenon once occurred at a UK National Championship. Everyone was waiting for the usual signs of thermal activity. The wind began to swirl and changed direction. The streamer went up at an incredible angle and there was an almighty rush of launch activity; more than a dozen models were launched. I tried to get the attention of my timer who seemed transfixed in her chair; after repeated arm waving from me she still didn't acknowledge my signal. I turned to walk towards her and as I did almost without exception all the gliders that had launched started to rain down on the runway! The thermal had collapsed; the best flight was about 12 seconds. As the streamer returned to the prevailing wind direction I launched and maxed !

NATURE'S LITTLE HELPERS

Nature can provide evidence of thermals. Small feathers, floating seeds and insects can all give clues as to when thermals are present. Look for these items floating towards you; if they are floating upwards then you may be sure that they are in warm rising air. Also look for circling birds which are hunting insects; they also give away the . presence of thermals.

THE BLACK ART

Now there is one method of thermal detection that cannot go unmentioned; it is almost a Black Art - the use of your legs !!

Using the skin of bare legs, back of hands or face to detect changes in air temperature and wind speed has many advantages, especially as there are some UK venues (Oxford) where thermal detecting devices are forbidden. Only the senior and more experienced free-flight competitors seem to have the ability to detect thermals using their legs, so watch them well and learn.

All the above rules still apply for the 'black art', warm calm air et; you must have a model that has a vertical launch pattern with a roll-off the top to ensure your glider is within the thermal you are sensing. All of the above advice applies to perfect days when there is only a light breeze; there will be days when the wind is very strong. On these days the lift will arrive and pass in seconds, so you will have to be alert and respond immediately the moment you spot the changes.

Conversely, on flat calm days you will have too much time to spot lift and it is on these days that you are most likely to pick false lift - the type of lift that collapses seconds after it formed! Only experience will help you get around that problem.

TECHNOLOGY

A common sight amongst the free flight glider, rubber and power fliers is a small pole (10ft), at the top of which is an anemometer made from the four halves of two ping pong balls and the sensor from a bicycle computer. The wind spins the ping pong balls and in turn the sensor gives an approximate indication of the wind speed. There is also a sensor for an electronic temperature gauge.
The displays for devices both are positioned at eye level. The anemometer gives the wind speed and the thermometer gives the temperature (of course). By watching the two and waiting for a combination of warm air and reduced air speed the detection of lift becomes 'easy' (ha ha).

I have tried watching these devices and tried to learn this new technique but be warned, - there is a tendency to become too reliant on it. Sometimes 'the old ways' are the best.

To reiterate :- Wait for the wind to ease off and then if the wind temperature rises and the streamer also rises - launch.

Now get running ~ Yippeee ! !

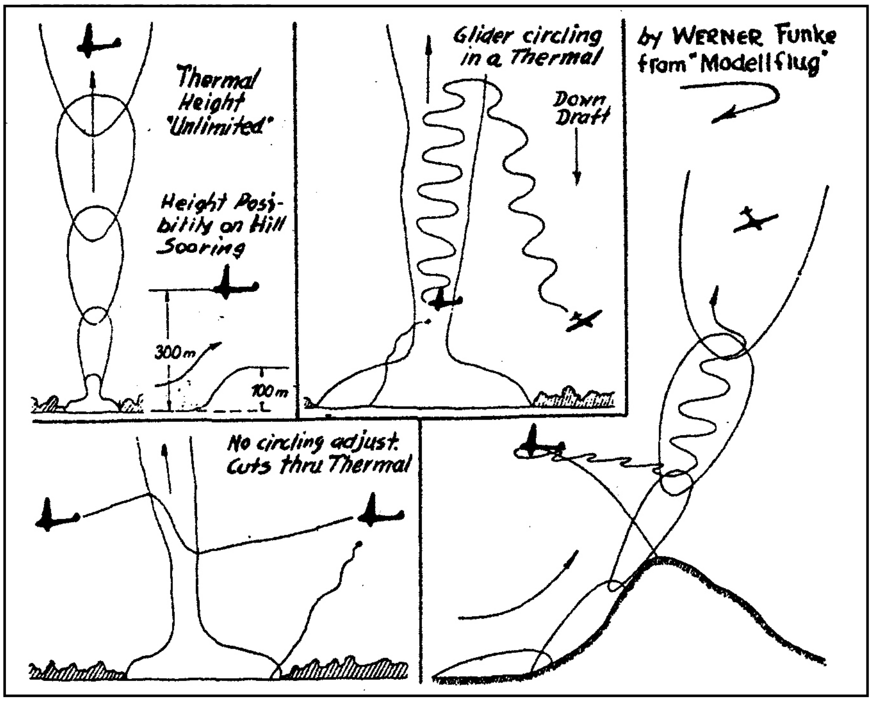
Final note

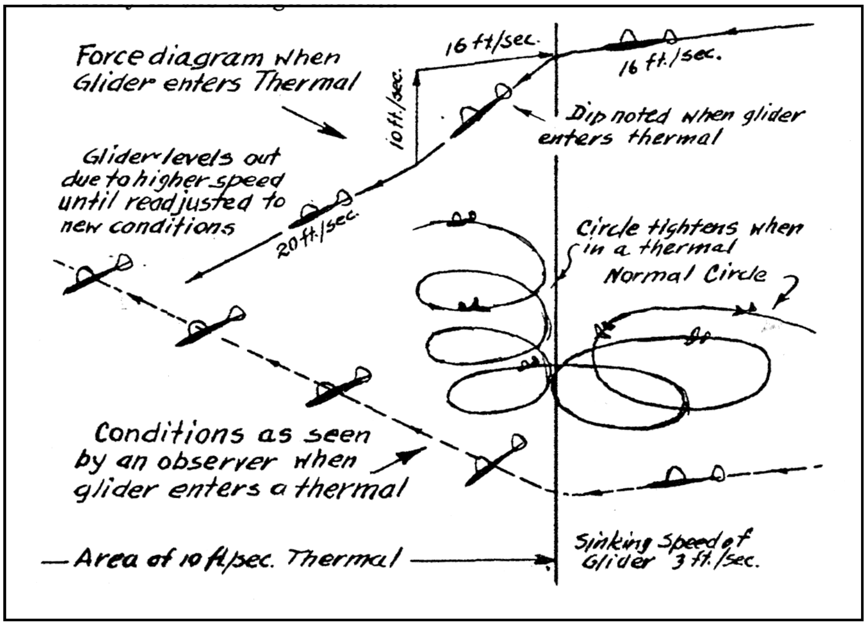
Mother nature wrote the rules for thermal generation and she re-writes them as and when she chooses - be warned, but enjoy yourself.

This final extract, looking at thermal formation, is taken from Frank Zaic’s book Model Glider Design and was quoted in an article in the 1981 NFFS Symposium Report.

While the ground was warming up the air above it, the dew and the mist evaporated. That is, the increase in temperature raised the saturation point so that the water vapor took its invisible gaseous form. As the warm air bubbled upward it naturally took along this water vapor. But as the warm air kept rising it was slowly being robbed of its heat by the surrounding cool air. With no means to keep it warm, the rising air eventually becomes as cold as the air around it. When this happens the water vapor again reaches its saturation point and mist is formed. More vapor is brought up by the warm air so that eventually there is enough mist or fog to be evident to us on the ground as a cloud. The size of the cloud depends on the thermal activity over a particular area, and general weather conditions. Wind will naturally tend to scatter or mix hot and cold air so that chances of forming a large cloud are slimmer. The part of the cloud building process which we use is the upward moving column of warm air.

If it takes a glider 1 minute to glide down from 100 ft. its sinking speed is 1½ ft. per second. So that if such a glider blunders into a thermal which is rising 1½ ft. per second we can see that the glider will remain at the altitude at which it hit the thermal. If the vertical speed of the thermal is more than 1½ ft. per second the glider will rise, and if it is less the glider will sink. This fact, the rise and fall of the glider due to thermals, should be evident to all.





When a model gets into a mild thermal the situation passes un-noticed until we begin to realize that minutes are piling up and the model is still gliding. But when the thermal is powerful we can see the action as it occurs. The model suddenly noses down and the circle tightens so that it looks like spin, and before we know it, the job is gone out of sight straight up. At one time when this happened we used to say, "Look how powerful is the thermal. The model is diving yet it keeps on going up!" However, a bit of thinking shows that this is a normal reaction. Let us say that the speed of the glider is 10 m.p.h. or 16 ft. per sec. and the rise of the thermal is 10 ft. per sec., rather on the powerful side. Placing these figures in a diagram we have a new airflow direction as shown. Rather steep. However, this condition may never be reached because as soon as the glider noses downward under the influence of the thermal the forward speed is increased so that instead of being 16 ft. per sec. it may be 20 ft. per sec. Placing this figure into the diagrams we can see the difference: With increase of speed, which varies with strength of the thermal, the turn adjustments we may have made for normal flying will be that much more powerful so that the circle will be of much smaller diameter, and chances of actual spinning are good if the model has delicate spiral stability balance. From the information given so far we can say that when the thermal is mild the reaction is almost unnoticed. But when it is powerful the glider will nose down, speed up, and tighten its turn. Since the thermals have limited dimensions the value of tight circling is self evident. Hence the reason for our stressing the spiral stability in the design section.