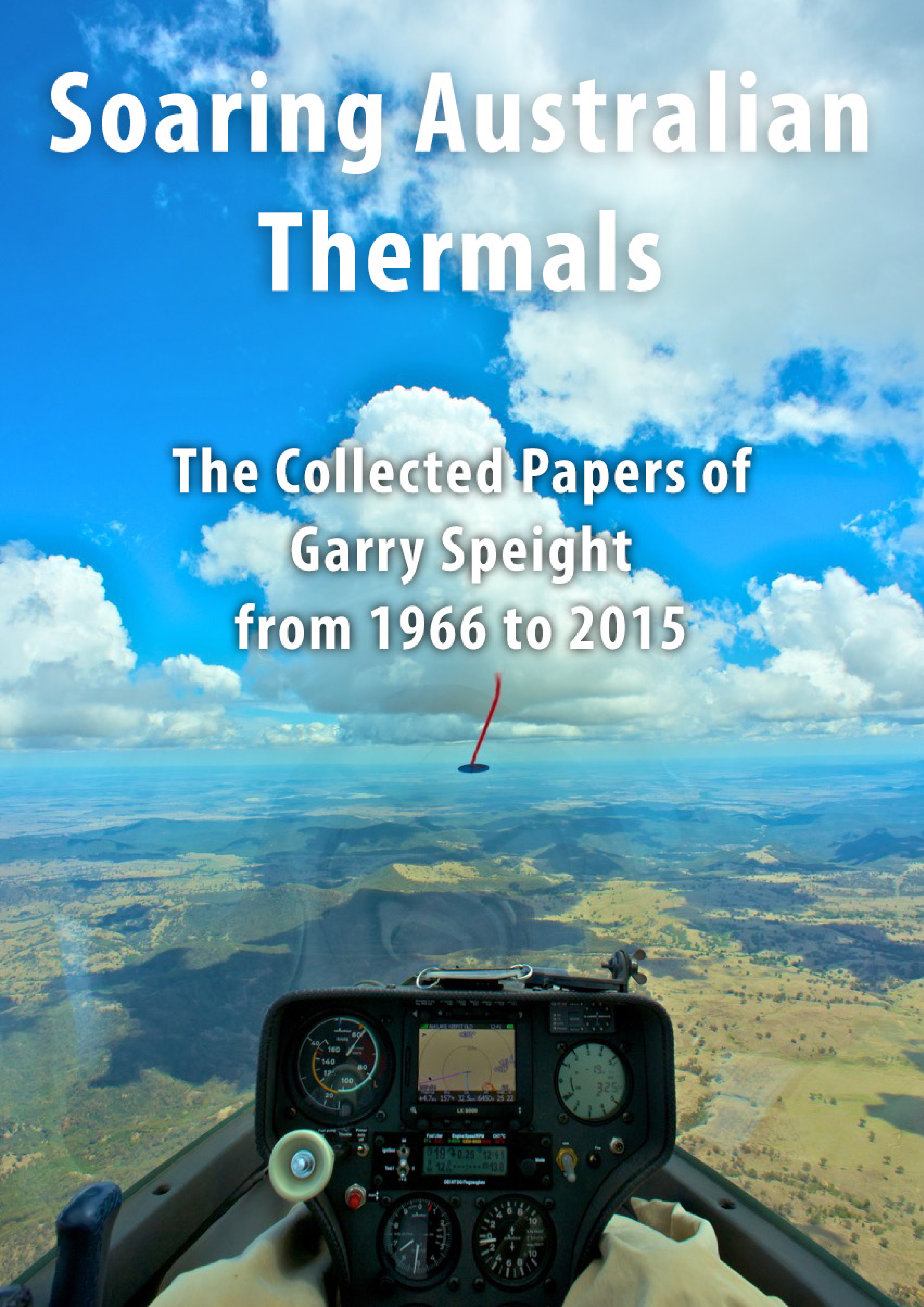
# Soaring Australian Thermals

## The Collected Papers of Garry Speight from 1966 to 2015



# Climbing Faster

By Garry Speight

*Originally published in Australian Gliding, October 1983*

If you want to cover ground quickly in a sailplane, you have to climb quickly. You may be an efficient MacCready flyer, and skilled at finding thermals, but you will make slow progress if you can't get the maximum rate-of-climb out of a thermal.

The first essential is accurate flying. The only way to be sure of staying in a thermal is to hold the speed and rate of turn almost perfectly steady.

The speed must be held constant, and as close to the stall as possible consistent with *complete* control of the aircraft in the worst tail-wind gusts.

The bank must be held accurately at an angle that depends on your judgement of the size of the thermal, and the yaw-string must stay in the middle.

Letting the yaw-string wander not only causes enough drag to spoil your rate-of- climb; it. also changes the rate of turn, distorting your circle.

It often happens that a gust blowing outwards from the thermal centre will reduce the rate of turn to zero without affecting the angle of bank.

The horizon is seen to stop rotating past the nose. If rudder is not applied immediately to return the yaw-string to the middle and get the turn going again, the glider will be completely outside the thermal in about five seconds.

Aids to accurate flying in thermals include canopy marks that show both the angle of bank and the level of the horizon in a typical thermal turn, and a well placed yaw-string with a zero-mark.

For a given size of thermal the best angle of bank depends on the wing loading. Heavy ships must bank more steeply.

Some calculations by Ken Caldwell, using my proposed "normal" thermal, give the interesting result that the best rate of turn is practically the same for most gliders: about one circle each 21 seconds.

It is worth practising to try to achieve this rate of turn consistently. I guess that most pilots, like me, take more like 30 seconds if they don't work at it.

Once one's circling technique is adequate, the remaining task is to get centred in the thermal, and to stay centred as it fluctuates and shifts and re-forms.

In a reasonably big thermal the most useful technique is to notice which part ofthe circle has the weakest lift and to shift the circle directly away from there.

In "Cross Country Soaring", Byars and Holbrook wrote in capitals: "NEVER FLY THROUGH THE SAME BAD AIR TWICE". They wrote it four times, including once in *ITALIC CAPITALS*.

The bigger the drop in lift, the bigger the shift should be, but it generally pays to keep making corrections even if the lift is nearly even all round.

Thermals slowly change shape, as you can see by watching the billows in a column of smoke. The point on the circle that has reduced lift on one pass often is much worse the next time around. If you fail to make a correction as soon as you can detect reduced lift, you may find after a couple of turns that the lift has vanished and you don't know where to look for it.

Most mechanical variometers respond fairly slowly to changes in lift so that the part of the circle that actually has the weakest lift may be more than 40° back from the part with the lowest instrument reading.

This does not usually bother a pilot who has practised a lot with a particular instrument, but it can be a problem for one who flies a number of aircraft with different instruments.

Modern electrical variometers are effectively instantaneous in response for the purpose of thermal centring.

The latest variometers usually have an "audio" output as well as a dial. The audio makes a sound that rises in pitch with increasing rate-of-climb, A common convention is to have a chopped tone for lift and an unbroken tone for sink.

The fact that the pilot no longer needs to look down at the instrument not only makes life safer for other pilots in the same thermal, it also makes it easier for the pilot to identify the part of the circle that has the weakest lift, as he can look at the landmarks outside while listening to the variometer.

It is a pity that many two-seaters used for training do not yet have an audio variometer, so that trainees can be taught to keep their heads up.

## Stimulation

Until very recently, all variometers indicated, both by dial and audio, the actual rate-of-climb. Centring depended on the pilot's detection of variations in this rate of climb.

Consider a pilot who is working zero sink below 1000 feet. When he knows he may outland in two minutes, it concentrates his mind wonderfully. At the same time the vario is giving a very positive signal about the location of the thermal: "beep" for lift; "wow" for sink. The pilot knows he must get more "beeps" than "wows" if he is going to get away.

By contrast, at 6000 feet in an 8 knot thermal the pilot's "high", brought on by his God-like situation, is encouraged by the instrument, which beeps hysterically in the best lift and only slightly less hysterically in the weakest.

Yet, circling in zero sink should be a rare occurrence related to bad luck or misjudgement, whereas circling in strong lift should make up nearly *half* of a typical cross country flight.

The usual variometer signal thus fails to stimulate the pilot to climb faster except in the one case where he is strongly motivated already!

Some of the more complex variometer systems, incorporating a speed director based on MacCready theory, offer a way of encouraging continual effort in thermals.

Using such an instrument, one can, by leaving it in the "speed command" mode instead of the "vario" mode while thermalling, get a signal similar to that of a variometer that has its zero displaced upwards to the MacCready setting.

This makes the instrument signal "sink" every time the lift falls below the MacCready setting, thereby spurring the pilot to work harder.

At least two variometer systems now have an option in which the "vario" mode signal itself is displaced upwards to the MacCready setting.

In a previous article (Australian Gliding, August 1983) I described modifications that Mike Borgelt built in to an Air Data System for me, that included this feature. The main purpose was to give a more positive indication of when to circle and when to leave a thermal.

As a spur to faster climbs in thermals, however, this is only a partial solution. Some thermals may be considerably stronger than the MacCready setting, yet one may not wish to fiddle with the setting but to keep it as a consistent reference value. The audio will then scream away in almost as useless a fashion as in a simpler instrument.

## Use of averager

Variometer systems often have an "averager" that displays the average rate of climb (or descent) achieved in the last 30 seconds or so.

This was originally intended to give a realistic rate of climb to use in MacCready calculations.

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It may also be used, however, to stimulate efficient thermalling. It serves as a reminder of what has been recently achieved, as a minimum to aim for in the next circle or two.

One can also, at least theoretically, cross-check between the vario and the averager to see how bad the weakest lift is relative to the average, so as to know how much to shift the circle.

Mike Borgelt has suggested to me that the averager can be made more effective in this role by electronically subtracting its value from that of the vario and using the **difference** to generate the "vario" audio signal.

This provides a pattern of signals like those of the low-altitude zero-sink situation, where "beeps" signal good air to be used and "wows" signal bad air to be avoided, so that the pilot is given the most compelling advice on maximising the rate of climb, the more so if a quiet band is inserted between the "beeps" and the "wows".

It is necessary to ensure that the instrument does not encourage the pilot to persist with **negative** rates of climb, by automatically switching the averager in and out at zero sink.

In fact, it is logical to link the device into the MacCready system by switching it in only when the rate of climb exceeds the MacCready setting instead of zero sink.

In this case the instrument will advise the pilot to begin to circle only when the lift exceeds the MacCready setting, then will give continual advice on the best and worst parts of each circle until the lift falls below the MacCready setting, when the lift indication will cease, signalling that the thermal should be abandoned.

At my request Mike Borgelt has incorporated these modifications into my Air Data System.

I believe that I am now getting clear and reliable advice on how to maximise my rate of climb for the whole time that I am in useful lift, by way of a single audio signal, with no need to look at the instruments at all, except when I decide to adjust the MacCready knob.