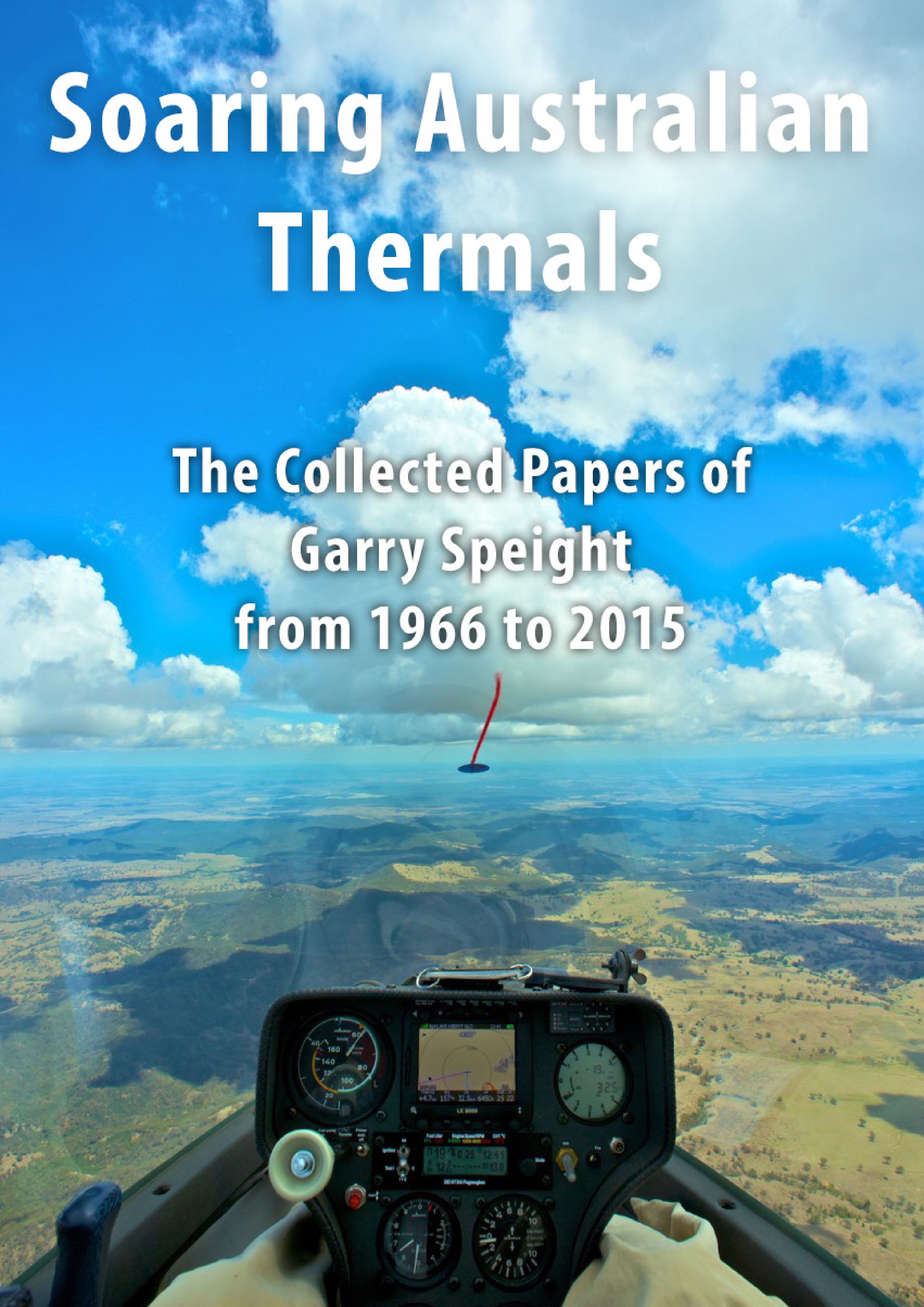
Soaring Australian Thermals

The Collected Papers of Garry Speight from 1966 to 2015



Optimal Flight Strategy

By Garry Speight

In this letter to "Sailplane and Gliding" I suggest that Anthony Edwards' ideas about probability and the Critical Rate of Climb should be used in cross country soaring. This led me to propose the practical "Rule for leaving a thermal" in a later article. For that, I also made use of a letter by Jan de Jong, re-published here.

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Dear Editor,

In Frank Irving's review of MacCready theory developments he summarised an attempt by Litt and Sander to incorporate realistic limits on max and min available altitude, and variable strength and spacing of thermals. The "powers of prophecy" make this analysis quite unhelpful.

The correct strategy for MacCready flying is succinctly stated on the preceding page by Bernard Fitchett: "I set the 'speed-to-fly' computer to the average rate of climb I can reasonably expect if there is an obvious source of lift within reach at this speed, otherwise the setting will depend on one's height. Starting from a great height, you have more chance of finding a strong thermal, consequently I reduce the setting as I lose height or foresee difficult circumstances." Also in June issue (p.111) Platypus was using much the same idea in a computer simulation.

The framework for an explicit model based on this strategy exists in two articles written by Anthony Edwards almost twenty years ago and not yet followed up.

The first point from the arm-chair pilot (S&G, October 1964, p.364) Is that the MacCready ring should be set on the "critical rate of climb". This is neither the average rate of climb used for flight planning, nor the initial rate of climb in the next thermal; it is the min rate of climb that one intends to accept for thermalling. If the next thermal is weaker than the critical value one dolphins through it: if stronger, one circles in it. The inter-thermal glide speed is determined by this choice of a critical rate of climb, but it will be somewhat slower than the optimum speed that one would fly if one could prophesy the exact strength of the next acceptable thermal. However, the main point of this kind of MacCready setting is to guide decisions on which thermals to accept and which to reject.

Bernard Fitchett dearly implies that the critical rate of climb varies with height and with circumstances, including changes in the weather. The way it should vary can in principle be calculated using the concept of probability. This was well presented by Anthony Edwards in his article, "A Stochastic Cross-country, or Festina Lente", S&G february 1963, p.12. Although, as has been repeated ad nauseam, variations from the optimal inter-thermal glide speed have little effect on the average cross-country speed, provided the thermals are closely spaced and of equal strength, in real life the probability of completing the course, or even making it to the next thermal, falls dramatically as the speed is increased.

High speeds follow from high MacCready ring settings, and the probability of coming unstuck due to the steep glide angle is then enhanced by the way one discards weak or moderate thermals that may be the only ones left within range.

A strategy to keep the average cross-country speed up while limiting the likelihood either of a premature landing or of time- wasting scratching at low altitude is a matter of letting the balance of probabilities govern the critical rate of climb. It requires estimates of the frequency distributions of both thermal strengths and inter-thermal distances, and a model of the variation of thermal strength with altitude. Information on these must by now have accumulated on thousands of barograph traces.

From some very sketchy calculations I have made a set of cards to mount on the instrument panel showing the variation of critical rate of climb versus altitude under various circumstances. I believe the use of the cards, by

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reducing inadvertent risk-taking, is responsible for my very consistent scores in recent competition flights.

Frank Irving replies:

I would not disagree with Garry Speight's remarks, as applied to real soaring circumstances, but I think he is doing less than justice to Messrs Litt and Sander (and hence, by implication, to Helmut Reichmann) by saying that their analysis is quite unhelpful.

I thought I had made it clear in my article that, in practice, the results of such analyses cannot be applied exactly, because they all require powers of prophecy. You have to make do with what you can observe at any instant, but a certain amount of intelligent observation and anticipation is equivalent to a limited amount of prophecy. Such analyses then provide some useful guidance.

It is a good thing that various minds should investigate optimum trajectories, no matter how idealised. They improve our understanding of soaring, they help in the formulation of

"Near-ideal" practical strategies and they may well help in the design of better instrumentation. Who knows, PlatyProg may indeed hold the key to "near-ideal" behaviour?

How Glider Pilots Get There Faster

By Jan L. de Jong

Originally published in Sailplane & Gliding, October/ November 1982

Dear Editor,

I very much enjoyed the article "how glider pilots get there faster" by Frank Irving in the June issue, p20, and I would really like to compliment the author for his excellent survey. Yet, I should like to add a little comment on the rules for the "Litt and Sander optimal flight strategy" as given in table 2. In fact, I should like to propose to replace the rules 1 to 6 by the following two equivalent rules.

A. In any thermal climb only high enough to reach a stronger thermal at minimum altitude by flying with a MacCready ring setting equal to the present climb rate.

B. If there is no stronger thermal that can be reached following rule A, climb to maximum altitude and proceed with the highest feasible MacCready ring setting with which at or above the minimum altitude a thermal can be reached with a climb rate equal to or larger than that MacCready ring setting.

These two rules are very similar to the rules for the final glide which should read:

A'. In the last thermal climb only high enough to reach the finish at the minimum safety altitude by flying with a MacCready ring setting equal to the climb rate in the last thermal.

B'. If the finish cannot be reached following rule A', climb to maximum altitude and proceed with the highest feasible MacCready ring setting with which the finish at the minimum safety altitude can be reached.

The similarity between the A. and B. and A' and B' is not accidental: it is the result of the important but often overlooked point, that in case of altitude constraints the final glide problem model is more appropriate than the MacCready problem model for a cross-country flight.

Of course, the rules formulated here give the same optimum flight strategy as the rules in Table 2. The reason for reformulating them here is only the hope that in the form presented here the rules may be more easily remembered.

Jan L. de Jong, Eindhoven, Holland.

Frank irving replies:

Dr De Jong's rules are more succinct and elegant than the six they replace: an improvement always to be sought in mathematical matters. I am most indebted to him for bringing them to our attention.