OFF CENTRE FLYING ~ PATTERN SHOWN CLOSED UP IN WEAK LIFT.

LIFT LESS THAN +1m/s. GLIDER MAINTAINING HEIGHT.

THIS PATTERN IS CLOSED UP WHEN THE PILOT ANTICIPATES THE SEQUENCE OF MOVE MENT OF THE C.P. AND STARTS MOVING HIS BODY WEIGHT AHEAD OF IT, AND THE GLIDERS SPEED INCREASES OVER THE WHOLE CIRCUIT.

PROMPTS TO THE PILOT ARE:

- THE SUDDEN DROP AT THE STEEPLY BANKED TURN IN A DOWNWIND GRADIENT (C.P. AFT) IT PROMOTS THE PILOT TO TURN EARLY, RAPIDLY ROLLING FLAT TO CATCH THE FALL (C.P. TO SIDE)
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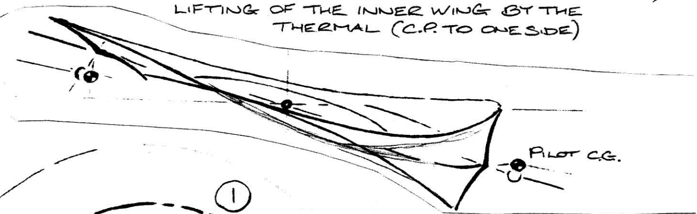
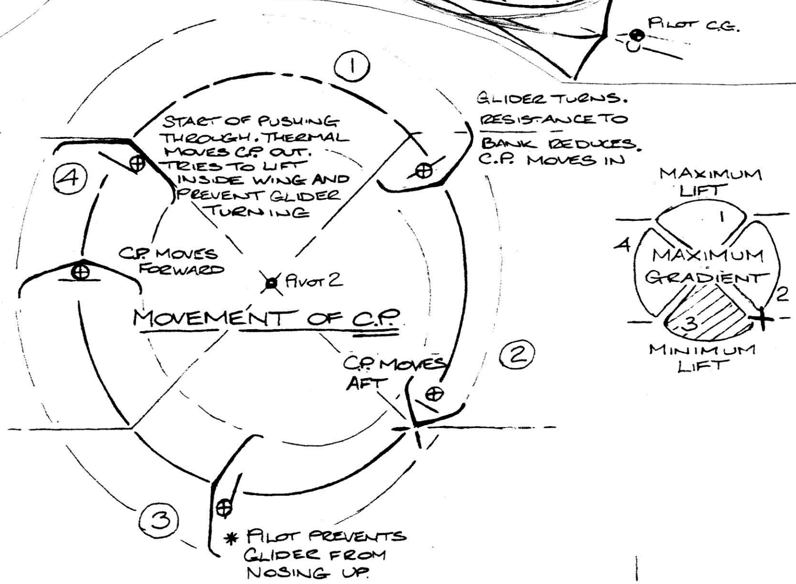
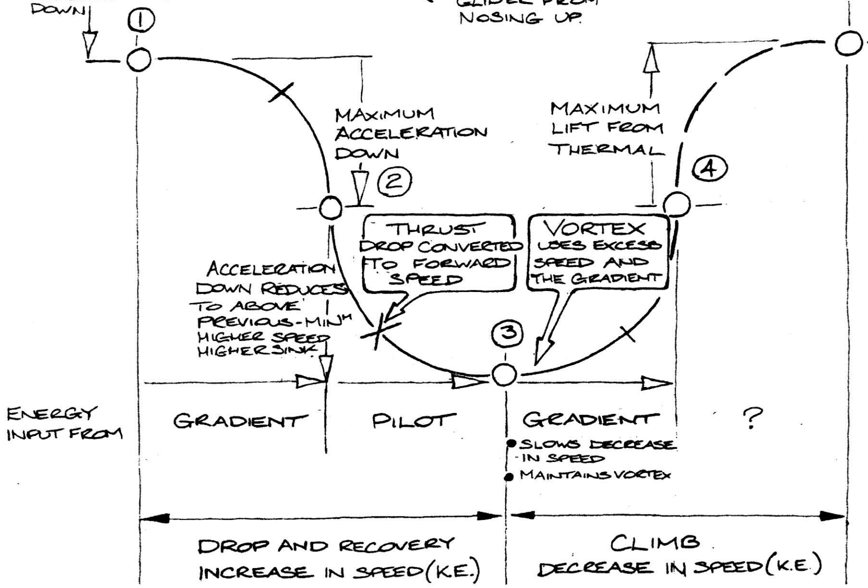


- THE GLIDER MUST BE TRIMMED TAIL DOWN. HANG POINT AFT.





VISITEURS DU CIEL H. AUPETIT Éditions Rétine 1990.

SENT PETER JAGO OCT 1990.

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A un point situé à environ 3 km au vent de l'aérodrome, Renner vira vent arrière à une altitude de 350 m et commença à plonger sous l'inversion avec une forte pente.
A une altitude d'environ 250 m, avec une vitesse de 200 km/h, il engagea un virage serré de 180° (accélération : 3 g) et cabra le planeur, sous le même angle (30°) que dans son piqué initial, face au vent.
Il retrouva son altitude de départ, fit un second virage de 180° avec une vitesse et un facteur de charge faibles et recommença la manœuvre.
De cette façon, il put garder son altitude pendant une vingtaine de minutes, mais le vent l'avait entraîné si loin qu'il lui fallait renoncer à son vol pour pouvoir regagner le terrain et s'y poser.
Au cours de vols ultérieurs sur un Pik 20, il acquit peu à peu assez d'expérience pour pouvoir remonter sans cesse contre le vent et rester au-dessus de l'aérodrome.

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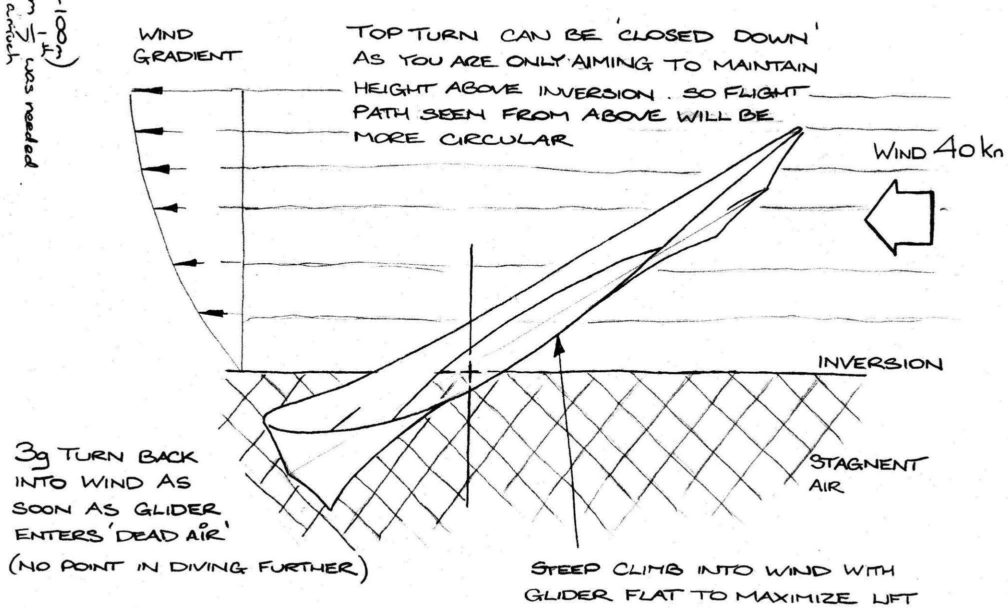

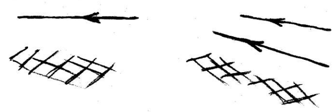

DS.

TO RETAIN AS MUCH AS POSSIBLE OF THE HEIGHT GAINED IN THE CLIMB AND TURN; AT ABOUT POINT 'A' THE GLIDER IS ROLLED FLAT, OR ALMOST, TO END UP FLYING BACK AT THE HILL WITH SPEED IN HAND.

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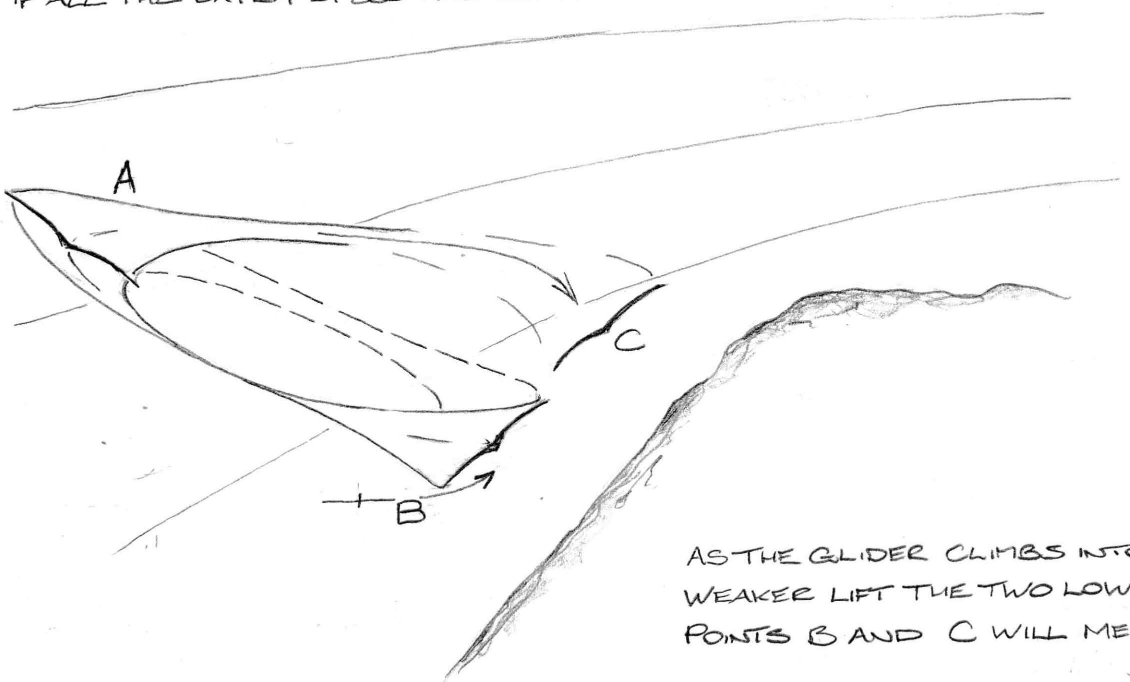

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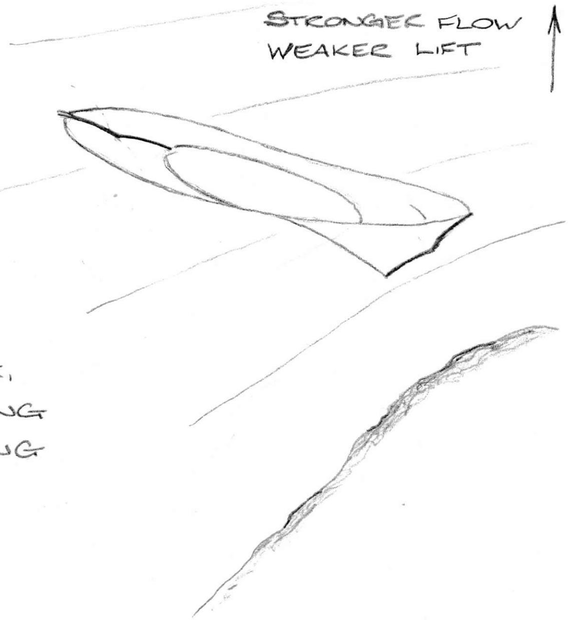
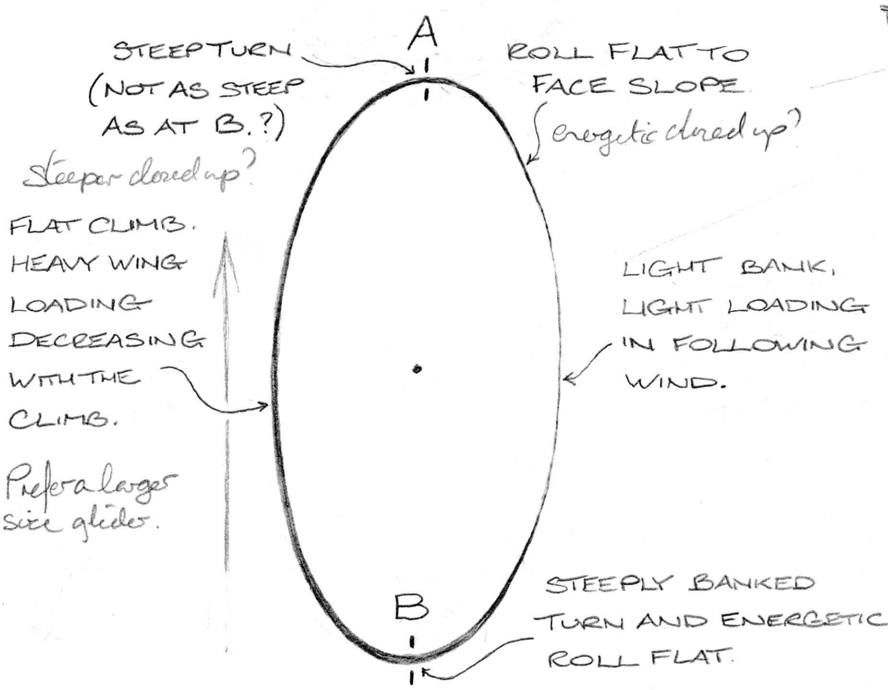




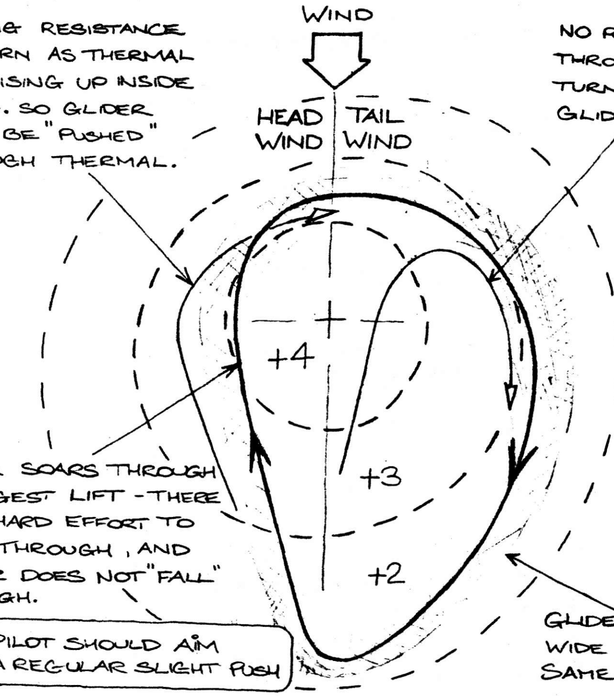
LOOKING DOWN FROM TAKE OFF RAMP.

FROM DIRECTLY ABOVE THE PATTERN IS CIRCULAR.

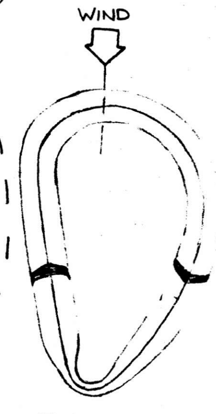
COMPLETE CIRCUIT CAN TAKE AS LITTLE AS 4 - 6 SECONDS *possibly less!*

STRONG RESISTANCE TO TURN AS THERMAL IS RAISING UP INSIDE WING. SO GLIDER MUST BE "PUSHED" THROUGH THERMAL.

NO RESISTANCE TO PUSHING THROUGH THERMAL. SO TURN IS QUICKER AND GLIDER "FALLS THROUGH".



GLIDER SOARS THROUGH STRONGEST LIFT - THERE IS NO HARD EFFORT TO PUSH THROUGH, AND GLIDER DOES NOT "FALL" THROUGH.



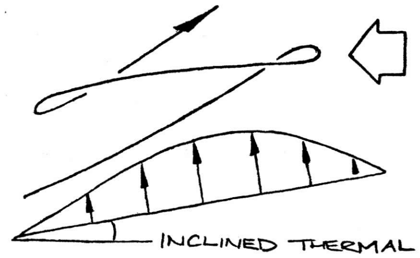
IDEAL FLIGHT PATTERN

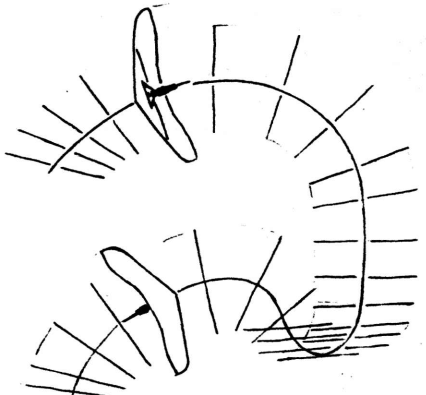
GLIDER CAN FLY IN A WIDE AREA KEEPING THE SAME RHYTHM.

THE PILOT SHOULD AIM FOR A REGULAR SLIGHT PUSH

FORWARD POSITIONING — VARY PAUSE BEFORE TURNING.

AFT POSITIONING. — GLIDER CAN CONTINUE UNTIL PILOT FEELS HE IS ABOUT TO FALL OUT OF THERMAL. ANY EXTRA SPEED PICKED UP CAN BE USED IN THE CLIMB.

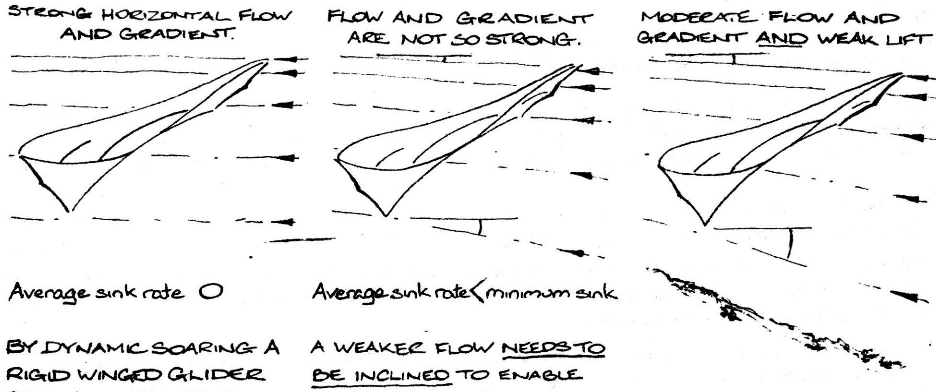




VIEW FROM WIND DIRECTION

CLIMB - PAUSE, PULL IN BAR A TOUCH - TURN - PICK UP SPEED WITH THE TAILWIND. - FAST STEEP TURN ROUND INTO WIND AS SOON AS DROP IS NOTICED - QUICKLY RECOVER FROM TURN AND SOAR INTO WIND.

EXTRACTING ENERGY FROM AN INCLINED AIR FLOW WITH A GRADIENT.



Average sink rate 0

Average sink rate < minimum sink

gravity also helps to pull the glider forward into the flow when it is inclined ?

BY DYNAMIC SOARING A RIGID WINGED GLIDER CAN STAY UP OVER ONE PLACE IN A STRONG HORIZONTAL FLOW WITH A GRADIENT. (eg RENNER/REICHMANN)

A WEAKER FLOW NEEDS TO BE INCLINED TO ENABLE THE GLIDER TO STAY UP ON STATION. THE VERTICAL COMPONENT (LIFT) IS STILL LESS THAN THE GLIDERS MINIMUM SINK RATE.

A HANG GLIDER NEEDS MORE ASSISTANCE SO THE FLOW IS INCLINED A LITTLE MORE.

WHEN DYNAMIC SOARING IN LESS EXTREME CONDITIONS TO THOSE DESCRIBED BY H. REICHMAN, FLYING A SIMILAR PATTERN AND WITH A LITTLE EXTRA HELP FROM THE INCLINED FLOW, THE PILOT IS ABLE TO REDUCE HIS AVERAGE SINK RATE FOR A CIRCUIT TO BELOW HIS NORMAL MINIMUM SINK, HE CAN ALSO CLIMB FASTER IF HE FLIES THE SAME WAY IN STRONGER LIFT, IF THERE IS STILL A GRADIENT.

RENNER WAS FLYING THROUGH A STRONG GRADIENT ESTIMATED AT 40 KNOTS — 20 METERS/SECOND PER 100 METERS, BUT REICHMANN CALCULATED THAT A GRADIENT OF ONLY 3 METERS/SECOND PER 100 METERS WOULD HAVE BEEN ENOUGH FOR THAT PARTICULAR GLIDER. SO AS SOON AS THE GRADIENT DROPPED TO AROUND THIS FIGURE THE FLOW WOULD HAVE NEEDED TO START TO BE INCLINED TO KEEP THE GLIDER UP.

NOTE: AT NO TIME DOES THE PILOT FLY ANY CLOSER TO THE HILLSIDE THAN HE WOULD NORMALLY FLY.

HE IS AIMING TO CIRCLE THROUGH A GRADIENT. HE DOES NOT HAVE TO PASS THROUGH ALL THE GRADIENT, TO THE SLOWER AIR CLOSE TO THE HILL.

THE PILOT WANTS TO MAINTAIN STATION WITH HIS CLIMB INTO AND TURN ACROSS THE WIND PEAKING AT THE AREA OF THE GREATEST FLOW HE CAN REACH, TO TAKE ENERGY FROM IT. THAT IS AWAY FROM THE HILL.

* There is NO suggestion that anything other than dynamic soaring effects are involved in this particular example with a rigid winged glider.
There may or may not be a temporary leading edge vortex.
There is no weight shift.
The control surfaces are too small for significant pilot power input.

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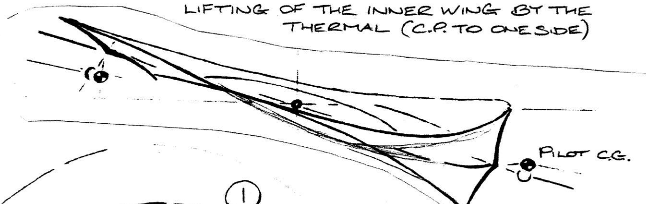

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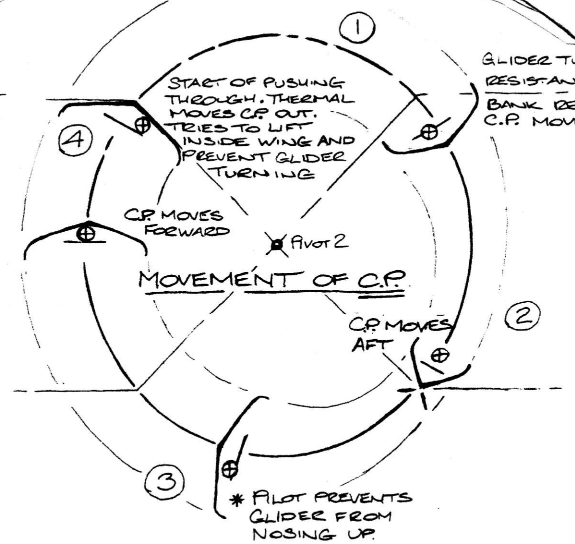

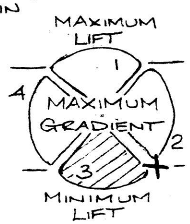

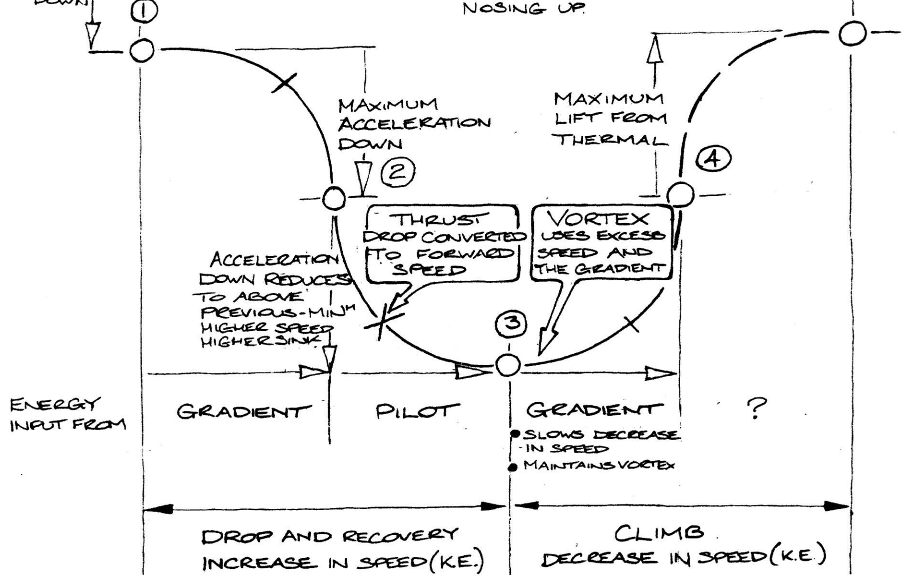

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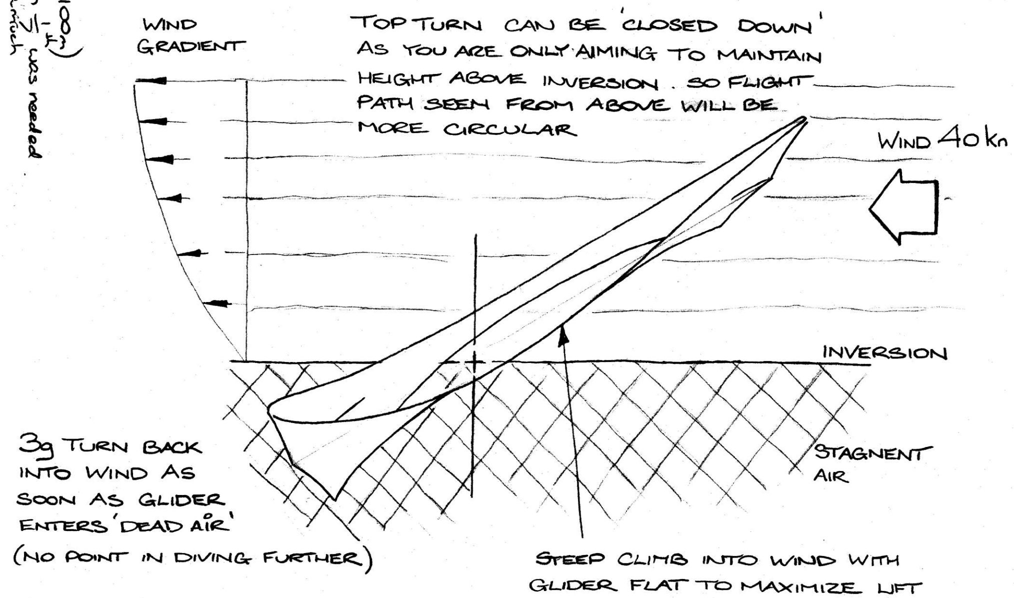
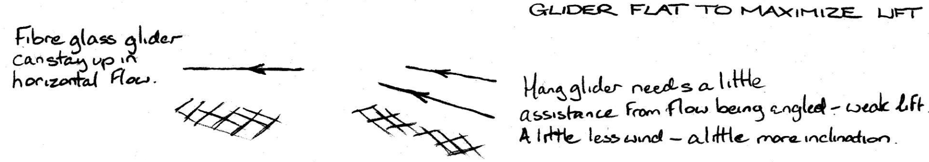
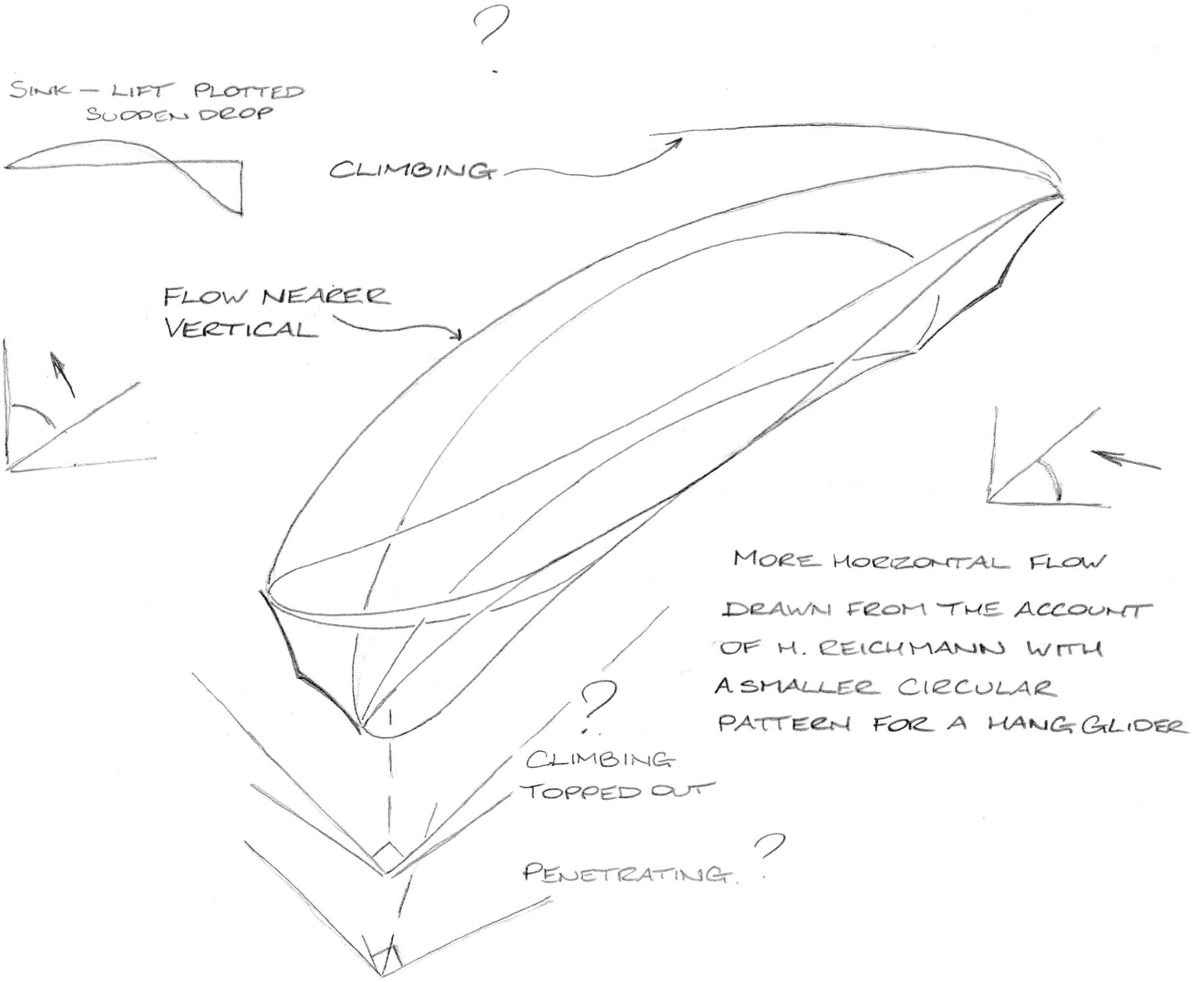
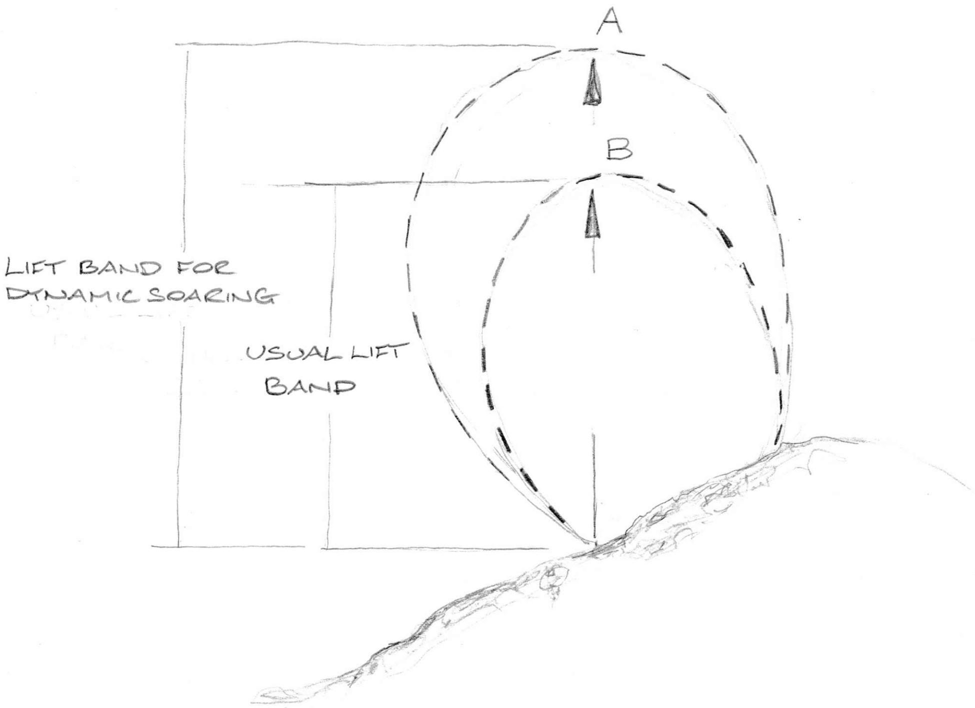








TIME TO CLIMB TO A = TIME TO CLIMB TO B

DYNAMIC SOARING FLYING NORMALLY

PATH OVER GROUND: *check for pilot input.*

A GLIDER IS MAKING GENTLY BANKED 360° TURNS IN STILL AIR. THE PILOT PICKS A POINT OF REFERENCE ~ SAY THE SUN.

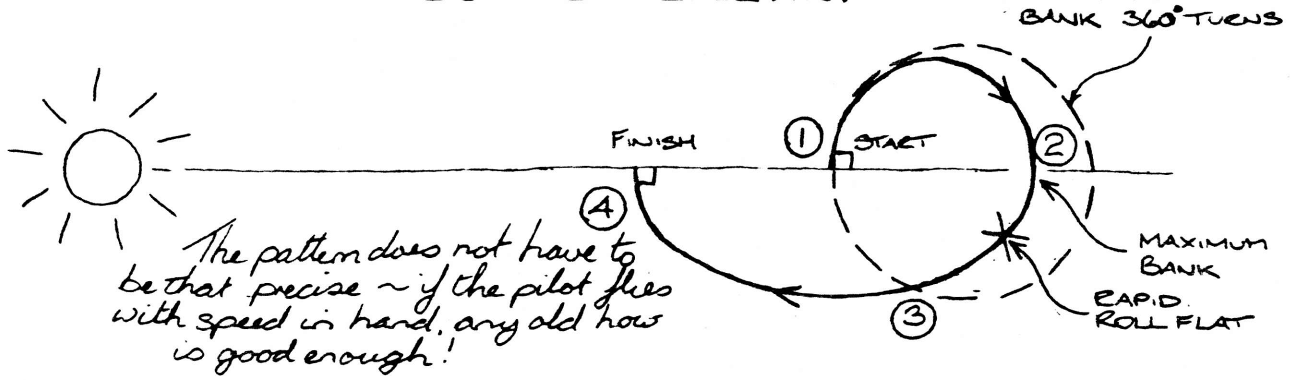
(1) WITH THE SUN 90° ON HIS LEFT HAND SIDE THE PILOT CONTINUES TURNING 180° PROGRESSIVELY INCREASING HIS BANK TO A MAXIMUM. THE SUN IS NOW ON HIS RIGHT HAND SIDE (2)

STILL TURNING TO FACE THE SUN THE PILOT RAPIDLY ROLLS THE GLIDER FLAT. IT IS ALMOST FLAT WHEN HE IS FACING DIRECTLY INTO THE SUN (3)

WITH ALMOST NO BANK HE CONTINUES TOWARDS THE SUN VEERING SLIGHTLY.

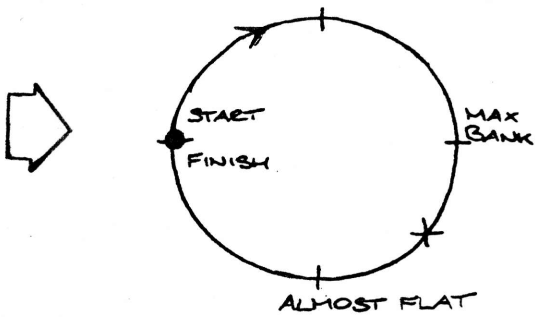
AS HIS SPEED DROPS HE SLIGHTLY INCREASES HIS BANK SO THAT HE ENDS UP WITH THE SUN 90° ON HIS LEFT HAND SIDE AT THE SAME SPEED AND ANGLE OF BANK THAT HE STARTED WITH. (4)

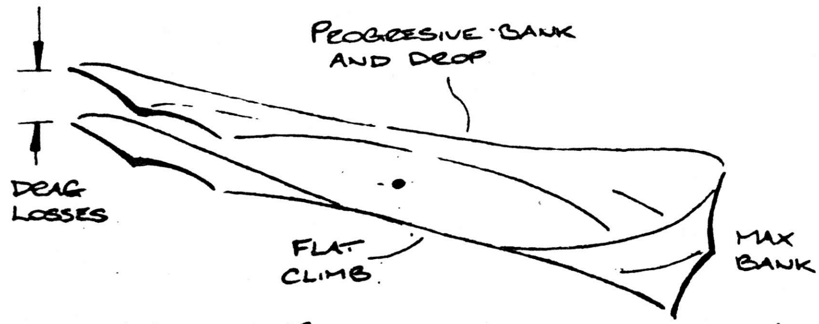
THIS IS HIS PATH OVER THE GROUND IN STILL AIR:



IF THERE IS AN INCREASING HEADWIND GRADIENT, BY VARYING HIS SPEED AND MAXIMUM BANK, THE PILOT CAN STAY OVER ONE PLACE ON THE GROUND.

VIEW FROM THE SIDE.



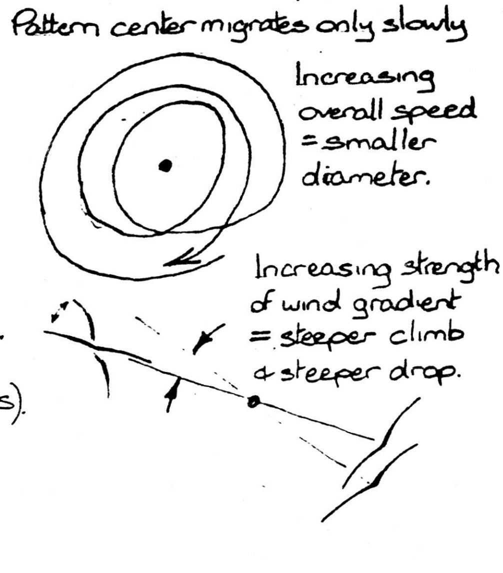


"TO SOME EXTENT THIS PATTERN IS SELF CENTERING AND SELF ADJUSTING, THE PILOT DOES NOT HAVE TO PAY TOO MUCH ATTENTION TO STAYING OVER ONE PLACE."

WITH THE HANG POINT AFT THE GLIDER NOSES UP EASILY AND CLIMBS RAPIDLY INTO THE GRADIENT AFTER THE DROP.

INCREASED BANK WILL MEAN INCREASED DROP AND INCREASED CLIMB. THEN TURNING EARLY IN THE CLIMB WILL BRING ON THE DROP, BANK AND RECOVERY EARLIER. (SMALL RADIUS). TURNING LATE IN THE CLIMB SLOWS THE GLIDER AND DELAYS THE FOLLOWING DROP (LARGE RADIUS).

A STRONGER WIND GRADIENT WILL STEEPEN THE CLIMB AND THE DROP. INCREASING OR DECREASING MAXIMUM BANK ALSO AFFECTS EVERYTHING ELSE THAT FOLLOWS. IN THE NEXT CYCLE.



Putting in bar earlier closes up pattern as overall speed is increased

closes up period to less than 6 seconds

TO RETAIN AS MUCH AS POSSIBLE OF THE HEIGHT GAINED IN THE CLIMB AND TURN, AT ABOUT POINT 'A' THE GLIDER IS ROLLED FLAT, OR ALMOST FLAT, TO END UP FLYING BACK AT THE HILL WITH SPEED IN HAND.

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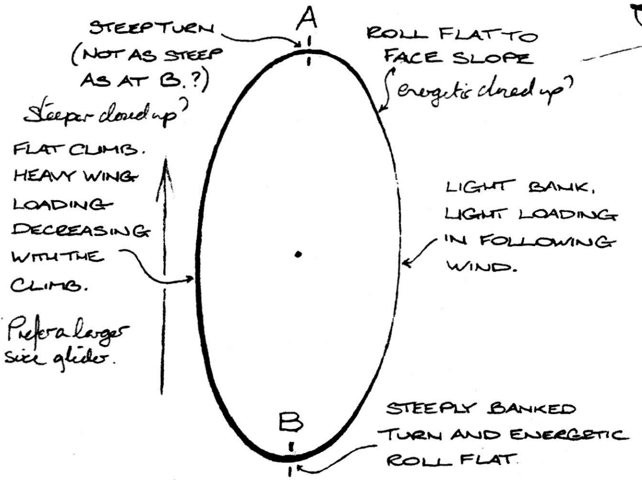
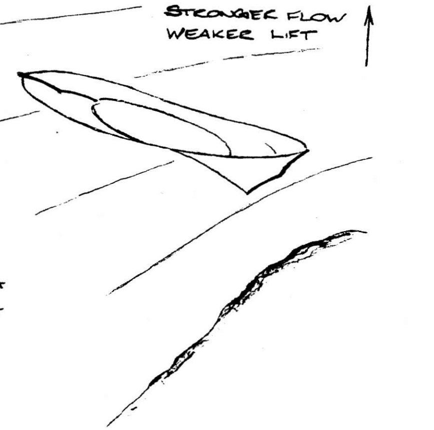
STRONGER FLOW
WEAKER LIFT

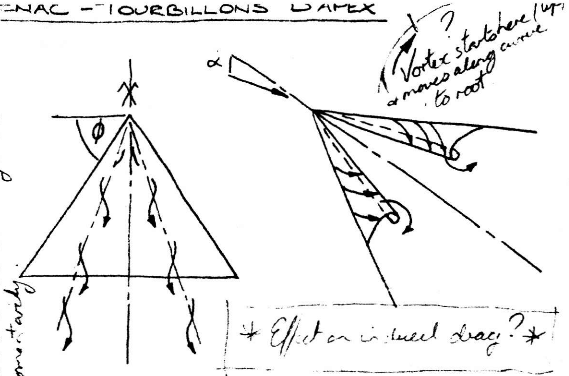




LOOKING DOWN FROM TAKE OFF RAMP.

FROM DIRECTLY ABOVE THE PATTERN IS CIRCULAR
COMPLETE CIRCUIT CAN TAKE AS LITTLE AS 4-6 SECONDS *possibly less!*

ENAC - TOURBILLONS D'APEX

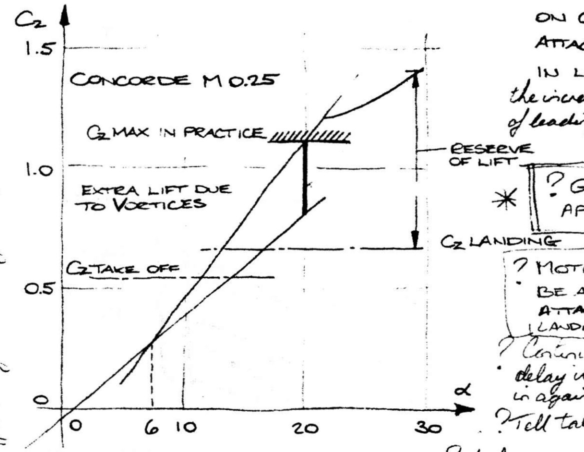


sweepback. Bar pulled forward (increases ... gives camber) as stalls blanketing ... leading edge. Bounce also bends in wing ends effectively increasing sweep back at tips momentarily

IF $\phi = 45°$, OR MORE PARTICULARLY FOR DELTA WINGS A VORTEX SYSTEM FORMS ON THE UPPER SURFACE STARTING AT THE APEX. WHEN THE ANGLE OF ATTACK GOES OVER 6°.

THE AIR FLOWS UP ROUND THE LEADING EDGE AND JOINING WITH THE TOP SURFACE FLOW FORMING THE 'ICE CREAM CONE' VORTEX.

WHEN THIS TURBULENCE FORMS THERE IS AN INCREASE IN SLOPE OF $C_{Z\alpha}$



ON CONCORDE AS THE ANGLE OF ATTACK APPROACHES 14° THE INCREASE IN LIFT REACHES 30%
the increase in gradient (encourages / assists) the setting up of leading edge vortices and delay their disappearance

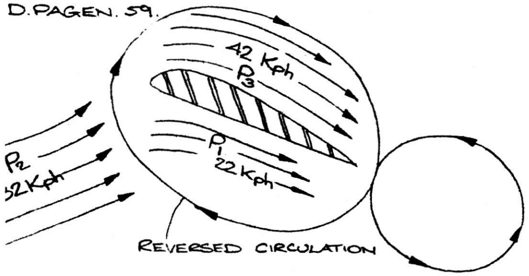
* ? GLIDER IS 'SURFING' UNDER APEX VORTICES ? *

? MOTORISED HANG GLIDERS ... WILL BE A COMBINATION OF SPEED + HIGH ANGLE OF ATTACK WHERE DRAG IS (SUDDENLY?) ... LANDING F.T.O. BUT MAY BE MISTAKEN FOR GROUND ...

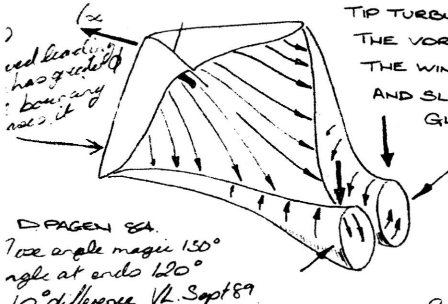
? Continued slight increase ... delay its disappearance as the bar is drawn in again. Even if ϕ is $< 45°$ Hg NOSE 120° ϕ 30° / 130° ϕ 25° *useful in climbing*

? Tell tales under leading edge

? shocks swimming same effect



ANY WING SETS UP THIS REVERSED CIRCULATION WHEN IT MOVES. THE HIGHEST PRESSURE IS AT P_1. P_2 IS ATMOSPHERIC PRESSURE, WHICH IN TURN IS HIGHER THAN P_3. THIS PRESSURE DIFFERENCE IS THE BASIS OF LIFT + DRAG.

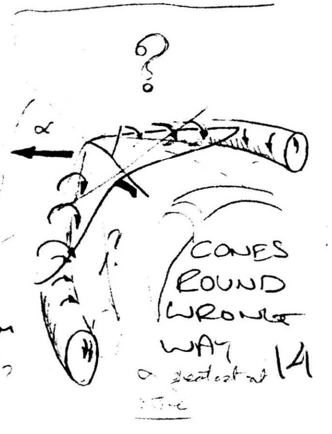


D.PAGEN 84.
Nose angle maybe 130° angle at ends 120° 10° difference V.L. Sept 89

TIP TURBULENCE IN NORMAL FLIGHT THE VORTICES FORM AT THE ENDS OF THE WING, EXPAND + JOIN UP BEHIND AND SLIGHTLY BELOW THE GLIDER

IN STEEP DYNAMIC CLIMB AIR CURLS UP OVER THE LEADING EDGE SO THE VORTICES ARE SET UP FROM THE APEX.

? Reduces (cancels) induced drag ?



14