

wings!

Official magazine of the BHGA

N.5 1979



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Cover:
Mick Maher flying
the Wasp Laser at Dunstable
Photo Ken Barker



wings!

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EDITORIAL

We are all hoping for reduced accident statistics within hang gliding this year — but there is one type of accident that I am convinced will happen before the year is out. Someone, somewhere will deploy a hang gliding parachute with drastic consequences.

Those of you who believe that a parachute is the magical solution to all hang gliding problems will probably scoff at this. If you do, then you are precisely the person who should read on and make some attempt to understand that a parachute is not a compensation for your own flying inadequacies. Nor is it a justification for flying in totally unsuitable conditions.

Hang gliding parachutes are intended as a last resort. They are the final hope that any pilot has in the event of a mid-air collision or glider break-up. Even then, they are only the hope of life and the chances of a pilot escaping totally unscathed are extremely slender.

There has always been a danger that some day a pilot will deploy his parachute instead of using his head when experiencing moments of panic that do not come into either of these categories.

But, after watching the parachute mania develop at close quarters during the last few months, I find the situation positively alarming. The person most at risk, as in most normal hang gliding accidents is the intermediate pilot.

The intermediate pilot, often with only a bare minimum of flying experience in terms of months, has now entered the parachute market with a vengeance. He understands little, if anything, of the logic in parachutes.

He is often in the lower weight range, but wants to buy the largest canopy possible — believing that the larger the canopy, the gentler his

descent to earth. His philosophy seems to be to buy "sooner, rather than too late". Here I quote one particular pilot who had been flying in extremely turbulent, windy conditions on a day when the majority of experienced pilots didn't even set foot outside their front doors.

It is often extremely difficult to make pilots in this category understand that firstly a light weight combination with a large canopy is totally unsuitable.

They seem incapable of visualising that a hang gliding parachute is not a steerable canopy, like conventional parachutes — and that with a very light weight pilot it will take longer to descend, travelling with the wind the entire time. In a very strong wind it will drag you through trees and power lines, at a cost of many limbs and possibly your life.

Secondly, a parachute is not a justification for flying in conditions beyond your own capabilities. Such conditions will probably be beyond the safe descent of your parachute anyway. So a pilot whose knees are knocking after a frightening flight in appalling conditions is heading for disaster if he thinks that a parachute is the answer.

In that situation, there is only one alternative. It is not a parachute. It is simply not to fly in those conditions.

Also, when you have a parachute, unless the actual repacking is done properly, every 90 days, your parachute deployment may be retarded considerably. Any time loss can be the difference between life and death. Make sure that you have it repacked by someone who knows how to do it — or better still learn how to do it properly yourself. You can do a two-day rigger's course with the army and become a qualified rigger if you have the time to spare.

Apologies to all pilots who have a sensible attitude towards the use of parachutes. The pilots heading for disaster are obviously in a minority — but even a minority of one is one too many.

JEANNIE KNIGHT

A NEW BREED . . .

Golf widows are the classics of the genre but now a new breed has appeared upon the scene. They are to be found, bag in one hand containing picnic, sweaters and waterproofs and on the other shoulder their share of a long, heavy bag.

Armed with these strange contraptions they embark upon even stranger behaviour. They toil slowly and carefully up a hill; not a calm, sheltered hill, but one which faces the full brunt of the wind. After a long struggle to the top these creatures are to be found in small groups pressed into the lee of gorse bushes, walls or hedges, wrapped in bulky clothes and lying on the same long bag, now devoid of its heavy contents. Occasionally they rise to peer anxiously over the face of the slope at bird-like contraptions floating in the sky. The only strong emotions shown by these inhabitants of the gorse bushes is when the bird-like contraptions sink slowly, gracefully to the foot of the hill. Anger, frustration can then be seen on the faces which peek out from the anorak hoods but resignedly they pick up picnic bag and long bag and, looking around for other paraphernalia on the hill, they turn and tramp slowly down.

Barbara Bedding

CASH!

CASH!

CASH!

Join the 500 Club and get yourself a ready income!

Details of the **CASH LOTTERY** which starts in September are shown on the insert with this month's magazine.

Don't miss this opportunity of earning yourself a huge, tax free cash prize each month.

If one third of the membership joins the scheme, you have the chance of winning £250 cash each month, each month, each month!

HURRY HURRY HURRY

THANK YOU FROM SUE MARATOS

Dear Editor,

I would like to thank the many friends throughout the country for their kind letters of sympathy, offers of practical help and the very beautiful flowers. It has been a great help to myself and Paul's mother and brothers to know that he was so well-loved and admired by everyone. My baby daughter and I are also very grateful for the trust fund which has been set up by the Pennine Hang Gliding Club.

Caroline and I are managing to survive each day, and as Paul and I were expecting another baby in November, there is new hope for the future.

Although I am deeply saddened by Paul's death, I do not feel bitter as I know he was a true enthusiast and it was something he loved doing. However, in future when I read of other deaths, I know that I shall feel sickened by yet another tragic loss of a young life; it just does not seem to me to be worth the sacrifice.

Sue Maratos
Manchester

THE REAL FLEX WING

Dear Sir,

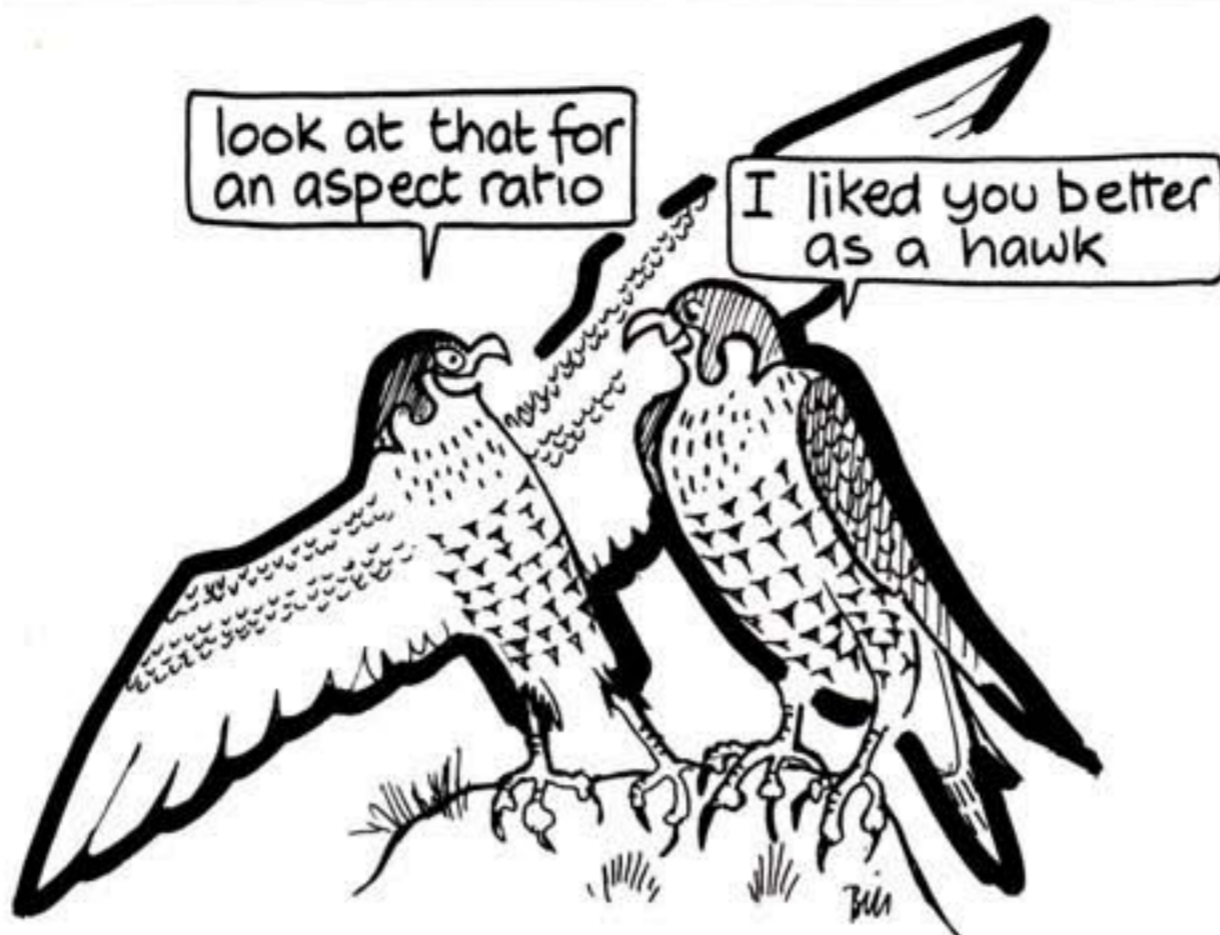
The prophets on the hang gliding front, who predict that improvements in performance will be marginal in the next few years, may dishearten those of us who dream of flying higher and further like our feathered friends.

Those of you who saw the programme 'Life on Earth', dealing with bird flight, and more importantly bat flight, will realise that nature does many things with wings that we don't. This is understandable because we are limited by our technology in trying to imitate their method of flight.

This prompts the simple question. What do they do that we don't? They vary their wing span, alter their angle of attack, change their nose angle and dihedral and also produce slots and flaps to slow them down on landing. By doing all these things, they have the shape of wing they need to do what they want. Why don't we? We seem to be stuck with the fixed wing concept because it's the best for power flying, but anyone who looks at bird and bat flight and is jealous must realise we could do a great deal more with what we have now as wings. What we must do is to flex them.

Let's look first at the leading edge. This is parallel for convenience sake and its flex characteristics are not ideal. In spilling gust loads it bends down between the nose and the wing bolt and only a little bit up at the wing tip. The ideal would be for the tube to be much more rigid inboard of the wing bolt and much more flexible outboard.

AIRMAIL



FALCON NOT HAWK

Dear Sir,

Whilst not wishing to denigrate Mike Lingard's interesting and enjoyable article, it should be said that the Peregrine, as one of the most impressive flyers amongst British birds, merits recognition of its being a falcon and not a

hawk.

The differentiation is not merely pedantic as, amongst other things, the falcon has a greater aspect ratio and is thus aerodynamically quite distinct.

Bob Baldwin
Brighton

This can be achieved by tapering the tube to about half its diameter from the wing bolt outwards. I have costed this out and it would be no more than about £1.00 per foot run. So this would add not more than £20.00 to the glider cost for a great improvement in turbulent condition flying. Those gliders that are still blessed with deflexors for sail control should have them sprung. Rather like a car valve spring, it gives when you want it to under a specific load and then regains its shape when the load is released. This would alter the wing tip in sweep in proportion to a gust load thus enabling safer flying in stronger conditions. The cost of this would again not be more than £5.00.

Similarly it would be possible to spring the side flying wires to give a change of dihedral in higher G loaded turns. So now we have taken a step toward a sprung frame, rather like the suspension on your car. Would you like to go back to solid axles? You know the answer, so why fly a rigid wing?

Anything that makes a glider safer to fly should be investigated. The Nationwide crash might have not happened if the glider was sprung. In smooth air all is wonderful, but in turbulence anything that makes the wing easier and safer to fly must be investigated.

The sail makers can help too. Lycra, that elastometric stretch fabric you should all know the feel of, could be included in a section

of the sail over the top of the sail keel pocket to give a variable washout control. This would not replace the sail fabric but would be in addition to it. I am aware that many will disagree with me but I will go so far as to predict that glider design will have progressed 30% in the next 2 years in the turbulent high speed end of flight.

Since we don't fly rogallas any more, we fly real wings, we must now flex them to refine their movement and so enable us to fly more like the bats and birds.

Those of us who like gliders with cross booms must dream of them being airfoil shaped. It amazes me why no one has pressed the tube-makers to produce such tube. It really is not so difficult as they make out. After drawing down the tube to size it can so easily be drawn once again through a shaped dye to give an airfoil shape. For experimental trials an oiled hardwood dye works very well in fact I shall probably have a go myself. More information when the trials have been made.

Ted Frater,
Corfe Castle, Dorset.

UNSCREWED CARABINA

Dear Sir,

On a recent flight I took off with the gate of my carabina screwed tightly shut. When I landed half-an-hour later I was alarmed to find the gate fully open. It appears that I had attached my harness in such a manner that the

knurled nut made contact with the top of the control frame upright. Weight shift movements were therefore causing the nut to unscrew. I fly a Falcon IV which has a rather long vertical section to the control frame.

The solution is clear. Always check that the carabina nut is facing away from the control frame and not towards it. For preference, choose a carabina with a nut that is fairly stiff to turn. Moral: Murphy is never idle and will always detect your oversights, however trivial.

Andrew Garnett
London NW3

Footnote: Other flyers report the same experience even when the carabina nut is facing away from the control frame. Suggested reason is vibration from the hang point causing the gate to unscrew during flight. Suggested solution is to insert the carabina so that the gate opening is at the bottom.

HIGH WIND READING

Dear Sir,

I have had rather a disturbing experience with a very commonly used wind-speed indicator and I think other flyers should be made aware of this.

I bought two wind meters after reading an advert in the December issue of *Wings!* The first time I used these was at Devil's Dyke, when, on a rather windy day, but with gliders in the air, they both indicated wind speeds of over 40mph!

When it was clear that both the meters were similarly in error in some way, I went to some trouble to have them checked. I managed in fact to test them in a large wind tunnel under precise conditions of use (ie. hand-held under truly realistic conditions).

The wind tunnel is an extremely precise modelling facility and in the presence of two expert witnesses the following values were obtained to a test accuracy of better than 0.1%

On the low range scale, the two meters gave readings of 5.8 and 5.1 miles per hour when the wind tunnel air speed was 5 miles per hour. At 10mph the readings were 10mph and 9.3mph respectively.

On the high range the readings were as follows: Wind tunnel, 15mph; Meter A, 17mph; Meter B, 15mph. Wind tunnel, 20mph; Meter A, 24mph; Meter B 24mph. Wind tunnel, 25mph; Meter A, 33mph; Meter B, 33mph. Wind Tunnel, 30mph; Meter A, 48mph; Meter B, 52mph.

During these tests, I tried various attitudes of the meters, partial blockage etc., to see if there was any undue sensitivity to pitch, yaw and so on. In fact the meters behaved very commendably and with no special attitude sensitivity. In fact apart from the obvious lack of calibration, there is no reason why such meters should not give good results.

I could only conclude that the meters are sold without any checks whatsoever. Clearly, if the error was

one of underestimation the consequences for an inexperienced flyer could be very serious. Even as it is, an inexperienced flyer would be led to think his glider had remarkable penetration capability!

The advert in *Wings!* claimed an accuracy of 1/2mph on the low scale and 3mph on the high scale. I wonder what safeguards are applied by our magazine when publishing advertisements? I have had no response from the retailer to my letters to them telling them of the situation.

How often do we have the chance to make such a good check of an instrument? We mainly have to rely on the integrity of our suppliers.

In case you are wondering why two meters — I bought one for another flyer and what an unkind present I almost gave him!

Sid Fisher
Dorking
Surrey

Editor's Comment. Wings! follows the normal code of practice relating to advertising standards. In this instance the supplier has offered to refund the purchase price and states that he had no reason to disbelieve the manufacturer's claims of accuracy. To his knowledge all meters are factory tested and this is the first instance of any fault.

PILOT HANDBOOK

Dear Sir,
With regard to the new pilot rating system. I am much impressed by the Pilot Handbook, I feel this is something which the BHGA has been needing to do for some time. At last it has arrived, and it has certainly been worth waiting for. However there are a few points I would like to take up which I feel deserve attention.

With the recent talk of take-off methods, I was surprised to read in the Handbook that gripping the 'A' frame uprights as a means of supporting and controlling the glider on take-off is now regarded as a particularly bad habit. It is contended that if the nose stuffs in, severe damage to wrists and forearms may result.

Although this may well be the case, I still regard this method of take-off more suitable than that endorsed by the Pilot Handbook. For instance, there is far greater pitch and roll control, and a better degree of support for the glider — thus less chance of crashing on take-off.

The method described in the Handbook as technique 2 does not afford the same degree of support and control over the glider. Also, if the nose did stuff in, the 'upright' wrist and forearms are still likely to be broken, along with the fingers of the hand gripping the lower bar. Finally, if sloppy technique is now synonymous with gripping both 'uprights', why do so many experienced pilots employ this method? (Take a quick look through some back numbers of *Wings!*)

More importantly, I would like to draw attention to some implications that arise out of the Pilot Rating system itself, and the conflict that exists between the pilot as a responsible decision-making individual, and the direction the BHGA is taking as a legislative body.

On the Pilot 3 task form it states 'The cross country, precision flying and power endorsement must not be attempted, or signed off before completing all Pilot 2 tasks' I agree that power flying should not be attempted until Pilot 2 is reached (indeed, I regard power flying to be something of a special case). But to forbid cross-country and precision flying until Pilot 2 is reached is a gross infringement of an individual's personal liberties. By what right can the BHGA say that pre-2 pilot is unfit to fly cross-country, or to do precision flying? Such restrictions directly imply that pilots are either too stupid, or are incapable of judging the limits of their flying capabilities for themselves.

As far as I am concerned, the attraction of hang-gliding today lies in cross-country flying. By prohibiting cross-country (and precision flying) to pre P2 gliding, is to remove one of the most attractive aspects of hang-gliding from a very large number of capable and responsible flyers. Surely this is unacceptable?

Bramley J. Murton,
Argyll.

Editor's note: Unfortunately some pilots are incapable and irresponsible and have to be restricted to protect the interests of the majority.

WELL DONE GERRY!

Congratulations to Gerry Breen who recently completed an epic world-record breaking powered hang gliding flight on his Hiway Super Scorpion. He flew from Abertysswg, Wales, to Norwich, covering a distance of 202 miles in four hours.

The general feeling was that he could have flown further if he hadn't run out of England. The flight astounded the Americans, who thought they had just captured the record with a flight on a powered Fledgling totalling a mere 160 miles.

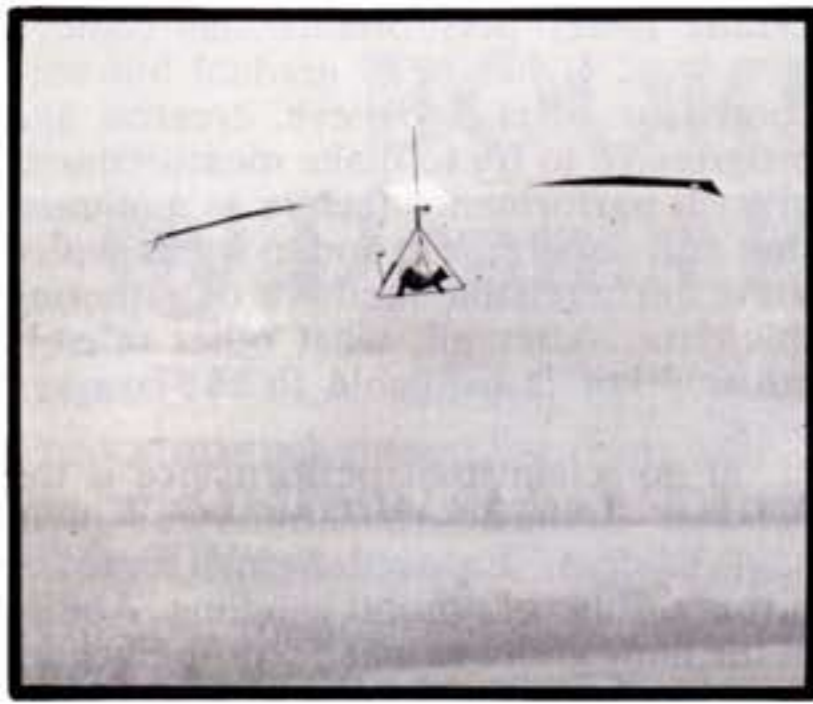


the Cherokee!



Birdman Sports





THE GEORGE WORTHINGTON COLUMN

Hang Glider Cross Country Performance.

All of us know how difficult it is to obtain accurate L/D performance of hang gliders. Manufacturers advertisements tend to greatly exaggerate the sink rate and the L/D of their product. Owners of a particular model are, quite naturally, prejudiced, and think of their glider as the best. So how do we find out which glider, irrespective of other attributes (such as handling, etc.) has the best performance?

I know I'm stepping into the "lion's den" and am subject to being bitten severely, because I am not an aerodynamicist, engineer, etc. I am only an interested pilot. However, I feel that I have valuable ideas for all of us on the subject of L/D and performance.

First I should try to define "performance" as it is used in this article. Since I am oriented to cross country flying, and since "cross country" seems to be the area in which most pilots are interested, the following definition is chosen. Performance is that comparative degree to which each glider is able to obtain the greatest efficiency on cross country flights. It logically follows that the following data will be important factors: (1) penetration (minimum sink rate plus 10 to 15 mph); (2) minimum sink; (3) efficiency in thermalling; (4) L/D and (5) controllability from a fatigue point of view.

In my view, with presently known methods, we cannot expect to adequately measure the differences, when they are relatively small, in numbers (3), (4) or (5). Where number (4) is concerned, we can, I think, demonstrate the *large* differences which may exist in L/D, between categories of hang gliders, such as between the modern high performance Rogallo and the Mitchell Wing. But I don't believe we can measure the smaller L/D differences, which exist, between the various models of modern rogallo type hang gliders as a group. Where numbers (3) and (5) are concerned, it will be difficult or impossible to eliminate subjectivity, and to obtain a high degree of objectivity. The answers in these two categories depends too much on each individual pilot.

I believe that in the areas of high-performance rogallas, the pilot is much more important to success in competitive cross country flying than the differences between individual types of gliders. When the differences in glider performance are

obvious, as they are, for example, between (a) the new Rogallos, (b) the new double surface Fledglings and (c) the Mitchell Wing, I believe such differences can overwhelm differences in pilot ability. In other words at the present time it would not be fair for a rogallo to compete with a new Fledgling in cross country competition. The Fledgling has an obvious and considerable advantage in performance.

In strong thermal conditions, other things being equal, a rogallo wing-loading of about 1.4 is going to be a big advantage in cross country racing as compared with a wing-loading of about 1.0. But what about weak thermal conditions, where the 1.0 wing-loading will be advantageous. It will be most difficult to prove which wing loading is absolutely the best for all cross country conditions. Some pilots will be using up to 50lbs. of jettisonable sand ballast in their cross country flights. This might help, and it might not. It will be very hard to prove.

So now we've briefly considered (3), (4) and (5). What about numbers (1) and (2)?

I believe that areas like Torrey Pines can be used to adequately demonstrate minimum sink performance of comparable hang gliders. If we take any two rogallas, for instance, and have the pilots fly together for at least 10 minutes, and as high as possible, on the North Face, we can measure visually (with adequate precision) which glider gets the highest. Now we must switch the 2 pilots and have them fly the "other" glider in the same test. Visual data can be gathered to adequately measure the difference and the general quantity of difference. If there is doubt, the 2 tests can be run several times. Such tests will be all the more accurate if the weight of the pilots (plus harness and helmet) is approximately equal. The difference in sail area and wing loading and tuning are factors, and so we are not truly measuring design efficiency, or one model of glider with another model. We are simply measuring the sink rate differences of two specific gliders with 2 specific pilots.

Another test which can be performed at areas like Torrey Pines is, I think, the most nearly representative of actual cross country performance. For this test, we need a wind of about 20 to 30 hitting the

cliffs perpendicularly. The test involves a race of 2½ miles (total) out and back, along the cliff. Speeds are much higher than minimum sink speeds. Hang gliders which may have very similar speeds at minimum sink, will often show remarkable differences when speeded up an additional 10 to 15 miles per hour. I believe this racing test, particularly when using the technique of "switching the pilot and glider for the second run", will clearly demonstrate a performance factor of great importance in cross country racing which I call "penetration".

Penetration is very important at those times, in such areas as Cerro Gordo, when the lift is strong enough to allow the pilot to use a significantly greater speed between thermals without regard to remaining airborne. A minimum sink speed will normally be used while thermalling. As soon as the pilot reaches the top of the thermal or reaches the altitude deemed to be best for his purposes (the strongest lift band, or a hypoxia-dangerous altitude, etc.), he is ready to proceed on course to the next thermal. It would be very useful if he could now add 10 to 15 mph to the speed which had been used for thermalling, *without* suffering an unacceptable increase in sink. If he can do this, his average cross country speed will be increased dramatically.

"Penetration" can also be vital in the area of safety. At areas like Cerro Gordo, we sometimes find ourselves with winds of 20 to 30 mph, coming directly up the mountain. At such times, we wonder if we are going to be able to penetrate out to the safe landing areas in the valley or whether the wind is going to prevent this. If we can't reach the valley, we will be forced into the very dangerous situation of having to land in the mountainous area. The more penetration which our glider has, the greater are our chances of reaching the valley. We usually play this on the "safe" side, and as a consequence we don't make the flight because we're not sure. A good example of this for me occurs as I alternate between flying the Mitchell Wing and the 10 Meter, in flights from Cerro Gordo to try to set a new World Record. I have seen only one day, from the launch site at Cerro Gordo, in the past 2 years, when I felt that the wind was too

strong for the Mitchell Wing to penetrate out to the valley safely. On the other hand, there have been numerous days when the wind seemed too strong for a rogallo. On those days, we have played it safe, and didn't fly. And we never knew whether we would have made it or not. The key was "Penetration" — or lack of it.

It is interesting to note that on the day in which the Mitchell Wing attained the present official world distance record of 95 miles, the wind at the launch site at Cerro Gordo was too strong (at the time of take off and also for all of the rest of the afternoon) for rogallos to safely "penetrate" to the valley. It should be mentioned also, that the Mitchell Wing reached the site where it was landed, with 9000 feet of altitude above the landing site. Therefore, an additional 18 miles (downwind) was "right there" for the taking, even without additional thermal help. The point is this. The wind was too strong for rogallos (six pilots

disassembled and *drove* down) but the thermals were there, and it was a great cross country day-all because of Penetration. So penetration is a vital factor and I believe it can be measured at places like Torrey Pines.

Maybe it is my imagination, but in trying to run the minimum sink tests and the Penetration Tests at Torrey, I have felt that there was a general reluctance among the pilots to be involved. They don't seem to want to risk "losing". It is as if their glider might be deficient but they'd rather not know about it. I would hope that this tendency will change. I'm going to try and change it if possible. It's fun to learn more about our ships!

In May of this year we plan to have some Torrey Pines hang glider races, in conjunction with the San Diego Annual Air Festival. I feel this might help orient pilots more to the fun and excitement of racing, which has been possible all along.

Hang glider performance has come a long way. It has been gradual but very consistent. It is, I believe, creative and progressive to try to make measurements of such performance factors as minimum sink and penetration, and to try to evolve some fairly reliable methods of gathering this data. After all, what other reliable information is available to the average pilot?

I do not claim that performance is the "end all" of the desirable traits we want in hang gliders. Ease of flying. Ease of turning. Ease of ground handling. Ability of the hang glider to make semi-parachute type landings. Stall characteristics. Ease and safety of landing. Tendency to tuck or break up in the air. All of these are also important. But, if we can get additional increases in performance without too great a sacrifice in these other traits, we should not want that. And we need to have a way to measure what we're getting.

SOUTH DOWNS HANG GLIDING CHAMPIONSHIP

AUGUST 25/26/27 1979 — AUGUST BANK HOLIDAY

The championship will be held at Steyning Bowl, on the Downs above Steyning village, West Sussex. The site takes all wind directions except W and NW, and was the venue for the Steyning Bowl Open earlier this month.

Don't miss this three-day event, which is being promoted to attract the general public as well as the hang glider pilot. It is open to all British pilots who are members of the BHGA and who hold a Pilot One certificate, or equivalent, or higher qualifications.

Trophies will be awarded for winners, with a trophy in addition donated by Knight Hang Gliding, which will be retained by the overall winner for a year.

This will be an event for all the family — there are attractions planned to cater for everyone, with the ever-popular Johnny Carr disco to be held on the Saturday evening locally. Licenced bar, as usual, at this particular entertainment.

Camp sites are available in the area and a list of other accommodation, with an indication of price range, will be sent to all entrants.

The event is being organised by the Steyning Bowl Management Committee, consisting of Johnny Carr, Tom and Jeannie Knight, Graham Slater and Dave Anscombe.

TASKS will be interesting, but not too demanding — this is intended to be a fun event as well as a good championship.

ATTRACTIONS will include the Johnny Carr disco, raffle, second-hand glider mart, displays by manufacturers and schools, and a range of ancilliary equipment.

ENTRIES should be sent as soon as possible to Jeannie Knight, 10 Spring Gardens, Washington, Pulborough, West Sussex. Tel: Ashington 892770. Entry fee is £5 for the full three days and includes parking and re-entry to the car park on all days.

MARSHALLS are needed for the event. All volunteers please contact Jeannie Knight. Food and drink will be provided for such helpers during the day.

HOW TO ENTER. Send a large stamped addressed envelope, plus £5, and a letter stating your name, address, type of pilot qualification and glider you intend to fly in the event, to Jeannie Knight. Your entry will be confirmed and fuller details of the event, with list of accommodation and car park pass will be sent to you on return.

BOOKS by Dennis Pagen

now B.H.G.A. officially approved and recommended (see Jan/Feb 'Wings!' P7 column 2) — and **DOWN** in price to **£4.00 each plus 20p UK postage** (Europe 50p) per book due to cheaper means of import and improved \$-£ exchange rate.

(Not yet stocked by B.H.G.A.)

HANG GLIDING FLYING SKILLS — Novice to Intermediate Instruction.

HANG GLIDING FOR ADVANCED PILOTS — Intermediate to Advanced Instruction

FLYING CONDITIONS — micrometeorology for the hang glider pilot — enlarged and improved March '79.

A Book on Power Flying is being written now — ready early 1980 — let me know if you would be interested.

ROBIN LAIDLAW — 105 CLERMISTON ROAD
EDINBURGH EH12 6UR

mainair sports

ARE YOU BUYING A PARACHUTE ?

I asked a man why he bought a particular brand of parachute. He said, 'Because it is the cheapest'.
Wow! I can think of no worse reason to buy a piece of life saving equipment.

He didn't ask if it had saved lives. He didn't ask how it was deployed. He didn't ask for a comparative report on its construction and strength. He didn't see it deployed from a harness . . . He just bought it and trusted the salesman with his life.

He saved about £30.

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WEIGHT SHIFT RULES, OK?

by Peter Robinson

Should we flexwing flyers be a little ashamed of flying a machine without 'real' controls like a stick and rudder pedals? Is weight shift really rather a crude and inferior control method, whose only virtue is simplicity?

The answers are No and No! For a glider where the pilot's weight is a large part of the all-up weight, weight shift control of roll and pitch is not only practical but is an aerodynamically elegant solution, capable of considerable refinement.

For tail-less machines like almost all hang gliders, weight shift control of pitch is an obvious choice. As sweep angles have decreased and aspect ratios increased, pitch control has become more sensitive. To maintain an adequate margin of pitch stability, some pilot effort is needed in moving above or below trimmed speed. But with trim capable of fairly easy adjustment on the ground, this is quite acceptable.

Admittedly weight shift control of pitch has well known limitations in one configuration — the powered hang glider.

Efficient use of weight shift in roll control got off to a slow start. Consider the progress of flexwing hang glider design over the last few years.

The 'bog standard' rogallo was very stable in smooth air and required a lot of weight shift to deflect from a straight path. In rough conditions its relatively narrow wingspan minimised its susceptibility to being turned by gusts.

The machines that followed, with their higher aspect ratios and wider spans, gave better performance, but at the expense of some undesirable handling characteristics. Sails were given much less billow. The larger spans slowed down roll response, so some machines were given reduced dihedral or even slight anhedral. This meant that less effort was needed to initiate a turn and to continue it. Indeed, this de-stabilisation could require opposite correction in a turn to prevent it tightening. This was something an inexperienced flyer might not be prepared for. Another effect of reducing the stability, in the interests of roll response, was a corresponding increase in the susceptibility of the kite to gusts. An increase in lift on one wing would require greater weight shift to correct it, not less.

So treating the kite more like a marginally

stable rigid wing gave reasonably high performance but with less than ideal handling.

The breakthrough started with the introduction of devices which turned the flexibility of the wing from a disadvantage to an advantage. These devices were the pulley system for deflexors, and the keel pocket. They allow the wing on one side to adopt a different angle of incidence from that on the other side, i.e. to warp or 'billow shift', under the influence of turbulence or pilot weight shift.

Consider the case where a gust induces a temporary increase in lift on one wing of, say, 10%. If both wings were to remain unchanged in shape and angle of incidence, this gust would need the pilot to compensate by shifting his weight sideways by, say, 10 inches for the duration of the gust. If the wings are allowed to billow shift, the heavily loaded side increases its billow, reduces its angle of incidence and thereby reduces its lift. The other side reduces its billow and increases its lift. The weight shift necessary to compensate for the gust is thus reduced to, say, 5 inches. Comparing this to the situation without billow shift where pilot movement of 10 inches was required, the stability has been increased by a factor of 2. This factor could be called the *roll control ratio*. Note that this RC ratio is only applicable to weight shift controlled aircraft.

Conversely, if the pilot wishes to initiate a turn, only half the pilot movement is needed on the machine with billow shift, assuming a roll control ratio of 2 as before.

Thus billow shift gives an improvement in roll response which goes hand in hand with increased stability in turbulence. This is in contrast to the reduction of dihedral to improve roll response, where this degrades stability as well as needing corrective action to limit the angle of roll.

What values of RC ratio are currently being achieved? A reasonable guess might be 2, possibly more than this at the 'min sink' end of the kite's speed range where the tips are fully working. The improved roll control that this represents is the major reason why there are now kites like the Birdman Cherokee, used by top competition pilots — yet also suitable for flyers straight from school. This is a welcome change from the situation over the previous three years or so. Since we left

the bog-rog behind and until recently it has been accepted that there were moderate performance kites for inexperienced flyers and high performance kites only for experienced pilots.

Think what it would mean if it were practicable to increase the roll control ratio to any value one wishes. Take as an example a kite with a span of 40 ft., aspect ratio of 8 and an RC ratio of 8 or 10. Pilot effort in flying such a kite, both in turns and in turbulence, would probably compare favourably with that in flying a conventional sailplane. Such a kite would require sensitivity from the pilot, not strength.

However, there are practical difficulties in achieving that ideal situation. The tighter the sail and the smaller the washout angle, the less opportunity there is for billow shifting, at least by conventional means. To date, the best techniques for promoting billow shift are deep keel pockets, carefully designed camber cut into the sail, and roaching (extending the chord of) the tips. The tips have most leverage and their lift has more effect on control than that of the sail nearer the keel. Indeed, even before keel pockets and/or pulley systems some small amount of billow shift occurred. The loaded wing would increase its tip washout and tighten the sail near the keel while the unloaded wing reduced its tip washout and slackened the sail near the keel.

One way of illustrating the general principle is to propose a 'rigid' wing, without drag rudders or other aerodynamic controls, but actually consisting of independent port and starboard wings. These would be freely pivoted about their leading edges. Their trailing edges would be attached to the keel via a pulley or pivot arrangement so that as one trailing edge rose the other was lowered. The wings would then between them maintain a constant average angle of attack but would be free (within limits) to compensate automatically for any turbulence, and would respond to the slightest movement of the pilot. The ultimate weight shift machine?

Interestingly, a somewhat similar control concept is appearing in aircraft at the opposite end of the scale, in large passenger transports like the Tristar. Here the object is not to prevent the aircraft rolling in turbulence but to minimise the gust

loads on the wing. This allows a longer, more efficient wing to be safely used. The gust alleviation is achieved by sensing the increased load and automatically adjusting the ailerons to reduce the lift. This 'active control' is in addition to the normal function of the ailerons under the control of the pilot. But remember — flexwings got there first!

Taking a deep breath and summarising: the roll control ratio for a weight shift glider may be defined as 'the amount of

weight shift to initiate a specified rate of roll, or to compensate for a specified lift asymmetry, if the wing does not change shape or warp (only a notional condition for a flexwing) *divided by* the weight shift for the same effect if the wing is free to change shape'. Another way of looking at the RC ratio is as the effective amplification of the pilot's lateral movement, due to the sail changing shape. Ratios well above unity are now being achieved, to a point where a flyer doesn't need hours of

air time before flying a high performance kite. Weight shift roll control still hasn't been exploited to the full, but with the record of ingenuity of hang glider designers we can expect further advances.

So, next time a bystander says to you 'How do you steer those things?' don't look at the ground and mumble 'By leaning one way or the other — bit like riding a bike.' No, look thoughtful and say 'Actually, it's rather a subtle and sophisticated system — not easy to explain . . .'

GUTE SIEGEL TEST PROGRAMME IN GERMANY

Hiway Hang Gliders Limited is pleased to announce that the Super Scorpion is the first British, indeed non-German, hang glider to have successfully completed the test programme for the German Gute Siegel (Goodness Seal) airworthiness approval scheme. This four-part programme involves flight testing, a crane-drop dive recovery test, dynamic pitch testing and static or dynamic load testing, and the requirements specified for all parts must now be met before a glider can be sold in Germany.

The tests are administered by the Deutscher Aero Club (DAeC) and have been developed over the past year, principally by Ali Schmidt (the manufacturer of the Falke glider) in conjunction with Paul Kofler. The DAeC has arranged the construction of a pitch-test car and manufacturers pay fees for the crane-drop and the test-car run and subsequent data analysis by an independent scientist. The DAeC has also made provision to permit the sale of gliders for which testing has not yet been completed, as well as for the individual testing and licensing for a limited period of older gliders. Needless to say, all this involves documentation, signatures and rubber stamps, but the DAeC has shown its determination to devise and maintain relevant safety standards for hang gliders which can be respected and supported by the manufacturers and users alike. The German standards will also be adopted or recognised in Austria and Switzerland.

The day arrived for the first batch of gliders to be tested at Tegelber, and 29 gliders were submitted for flight testing and the crane-drop. For each glider, a flight test report was completed by a pilot representing the manufacturer and a pilot from another company; these comprehensive test reports, which encompassed objective and subjective judgements on such features as reaction times and general "feel", were compared for each glider. We were pleased to learn that the 'other pilot' flying the Super Scorpion confessed to being very impressed!

The onlookers on that sunny weekend were astounded to see gliders being flown happily down the mountain, parked in a line and then



dropped free from a crane and — almost without exception — substantially bent; they imagined that it was a test to judge resistance to breaking. For the test, a 75 kg weight was attached to the hang-point but was otherwise unrestrained. The gliders were raised by the back of the keel to a height of 50 metres with the weight hanging through the control frame, and were then released. Since 14 of the 29 that day plummeted straight into the ground, those spectators not 'in the know' could well be forgiven for thinking that it was a test for airframe strength! The other 15 gliders pulled out of their dives very soon after being dropped and from the films we have seen, only one needed more than about 30 metres to pull out. The test gave a clear pass/fail result and a satisfying demonstration of the Super Scorpion's clean and gentle dive recovery. The films of those which did not pull out are frightening to watch, and in some cases illustrate tucking tendencies frustrated only by the unrestrained weight pressing forward against the nose.

The car tests produced a number of graphs for each glider, and the Super Scorpion's results were to date the closest achieved to the model standards for recovery from extreme attitudes. The tests were designed to investigate the static longitudinal stability of each hang glider by measuring — at a variety of airspeeds — lift, drag and pitching moment at a range of angles of attack from approximately 45° positive to 25° negative. Although unspectacular in comparison with the crane-drop, the quantitative and visual results obtained from pitch-car testing give the manufacturer an accurate and comprehensive profile of the characteristics and performance of a glider, both inside and outside the normal flight envelope. Measurements obtained from the rig also enable an accurate glide angle figure (without pilot) to be found. The ability to investigate hang glider behaviour beyond the range reasonably attainable by a test pilot is of immense value in glider design towards improved safety.

Joan Hunt

Preparing Super Scorpion for test



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FLIGHT REPORT

HATTERALL HILL TO ABERYWESYN (34 MILES)

Saturday, 14th April, saw me on Pandy Common with a South Easterly forecast but with a light to moderate North Easterly wind blowing. A slight covering of high cloud seemed to promise a dampening of thermal activity and indeed for the first hour few cumulus developed. I rigged leisurely and replaced my 'A' frame sides which I had managed to wipe out the previous day at Mere. Bob had done a few exploratory hops and confirmed there were good workable thermals. My pace of rigging doubled.

By the time I had finished and done a good pre-flight, Bob and Jerome had penetrated up to the North Easterly bowl. Despite being T-shirt weather on the Common, I donned a thick pullover and duvet jacket, the dreaded 'LJ's' now being a permanent feature. One of these years I must get round to washing them! Good cumulus had now developed (circa 2 p.m.) as I worked my way up to the North Easterly bowl — which was now very easy as the wind, had rapidly come round to the East. I observed from my non-too-lofty perch that Bob and Jerome had landed in the N.E. bowl and were obviously waiting for someone to find them a nice meaty thermal.

Andy Billingham proved to be our saviour and I joined underneath Andy and Jerome in a good 2 to 4 up. A 3000ft. with very little drifting back over the hill. I noticed Jerome a good mile out in front of the hill still climbing, this must be a massive thermal!

At 4000ft. I still wasn't near cloudbase. I kept squinting up trying to estimate how much more I had to go. Jerome was still a good mile away in front and still higher, Bob below was obviously working a good core and was streaming upwards about 1/2 mile down wind.

At 5000ft. it got distinctly cold and I was now a good mile downwind and heading surprisingly NW., the wind at this height was obviously light and South Easterly. I tried shouting to Jerome to join us so we could all go together.

We all reached cloudbase at 6700ft. (about 7800ft. ASL) where the temperature seemed well below zero. At this height there was reasonable visibility, Abergavenny was easily visible to the south, Llangorse Lake was visible to the West and the Wye Valley to the North.

Drifting at minimum sink with the wind led us in a NW direction. Hay Bluff below us looked like a small triangular landing field that it would be difficult to land in!

At this point Bob and I were well in front of Jerome who was obviously lingering in lift, my vario was showing a steady 5 to 6 down, should I head back upwind and join Jerome? I decided to plough on through the sink.

I was convinced I had made the wrong decision as I headed out over the Wye Valley with Bob; Jerome was now miles upwind several thousand feet higher and just an unreachable dot in the sky.

The sink seemed never ending, then Bob slowly rose in a weak thermal, I dived in below about 4000ft. above the valley floor. The thermal was weak and not very well defined, at least it would extend our flight. We both relentlessly hung onto the thermal and worked it for what seemed an eternity. As we slowly gained height we became more adventurous and as one of us worked one patch of lift the other would search elsewhere for better. It turned out there were several cores giving anything up to 4 up and several holes giving heart stopping 8 to 10 down — fortunately these weren't large and it was therefore easy to escape these engulfing 'black-holes'.

Suddenly Jerome joined us at the same height, I didn't even see him arrive. Three of us now searching out these small cores made life much easier and we spread out and at the same time kept a beady eye on each other. We played this 'king of the castle' game for well over an hour while drifting very slowly with the light winds. From Llyswen to the lower foot hills of Mynydd Eppynt we slowly but gradually regained some of our lost height and we were now averaging 5000-6000ft. above the ground. The visibility was still good and Builth Wells was clearly visible due North. The cumulus were well spaced-out and a lot of the time we worked small weak thermals that had no cloud to cap them.

Patience was the name of the game as we circled in zero lift for minutes on end while the terrain below us seemed almost stationary. We eventually came to the NW edge of Mynydd Eppynt directly over the B4520 road. We were now faced with a long thin valley stretching SW-NW about 5 miles wide and beyond that more moorland. After the steady lift over the high ground I expected considerable sink over the valley.

Again I was wrong, the sink was not bad. I wanted at this point to go on a more northerly tack towards Llandrindod Wells as the ground looked more hospitable and there appeared to be a valley which ran NW in our direction. Bob and Jerome were still heading NW towards what were the southern parts of the Cambrian Mountains (known by the locals as the Welsh desert), my motto being at a time of indecision to go with the majority — so I did!

Unfortunately the trap was sprung, we were now over Abergwesyn at about 6000ft. AGL and faced with what appeared to be an impenetrable

mountainous region. No apparent roads, several reservoirs, areas of forest, and a prospect of a night in the mountains. We were now over the last visible signs of habitation. A cross-wind glide could not guarantee an increase in distance as it was liable to be on an arc from Pandy.

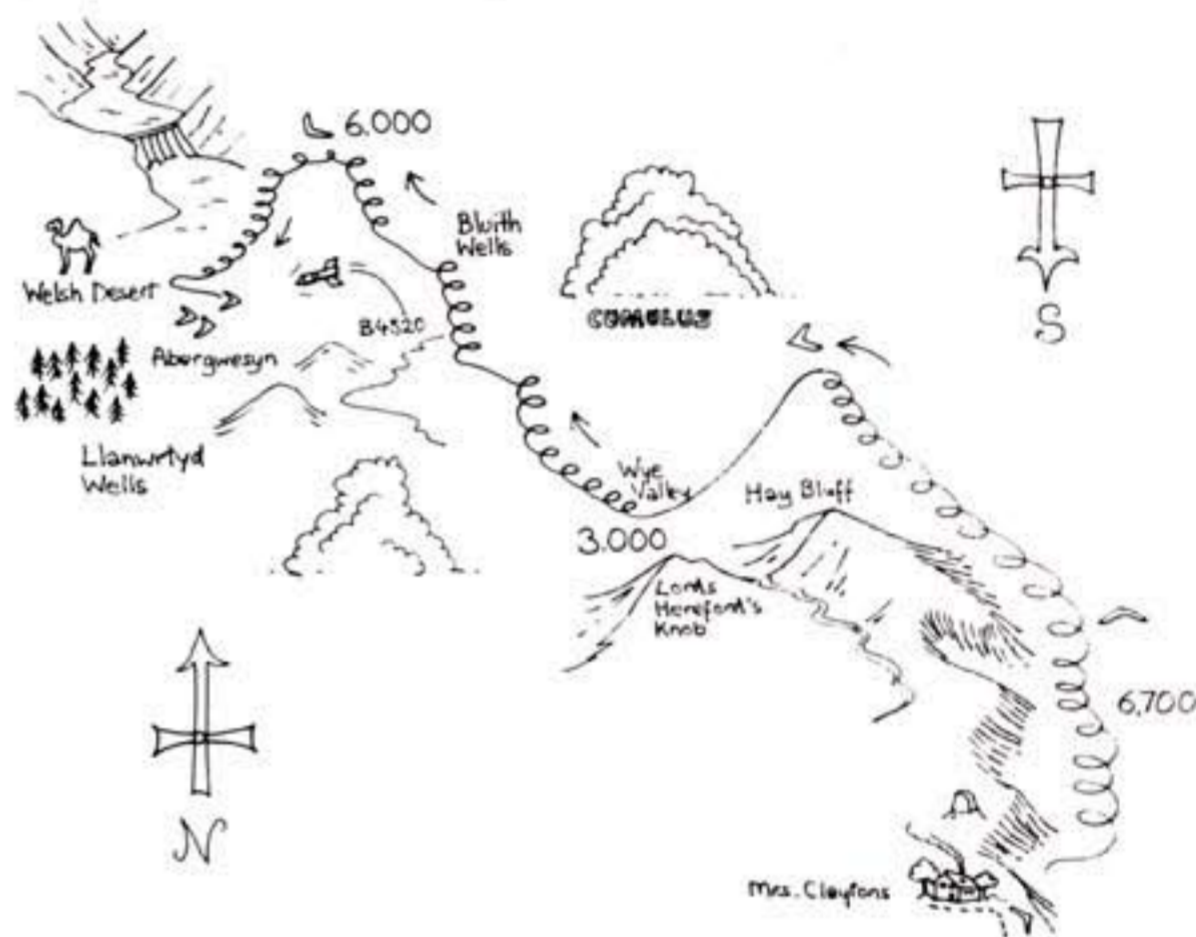
We all three burned off the 6000ft. excess altitude (it really goes against all your natural instincts as you can guess!). Bob landed at 5.10pm., Jerome at 5.15pm., and myself at 5.20pm. The flight had taken 2 3/4 hours approximately and I had averaged 5000-6000ft. above the ground

for most of the flight.

Two things were very clear from this flight, it is much more pleasurable flying with company — and also easier since thermal searching is done over effectively three times the area one person can cover.

If anyone was to ask any one of us how far we could have flown given suitable terrain after Abergwesyn, I think we would all agree that on that day 40 miles was a distinct possibility. Given a small amount of luck, 50 miles — my ambition for this year.

NIGEL MILNES



BAILEY CRACKS 50!

HANG GLIDING ACE REGAINS RECORD

Mr. Robert Bailey, 30, of 2 Denton Avenue, Leeds, a hang gliding instructor and member of the five-man team to represent Britain in the world championships to be held in California, in July, has regained the British distance hang gliding record he lost only four weeks ago.

Robert flew the 50 miles from Arncliffe, in the Yorkshire Dales, to Hartlepool in

two hours. His previous record of 30 miles, set in 1978, was broken recently by a flight of 34 miles in Bristol.

Robert's flight over Richmond and York ended in a field near Hartlepool and his height varied between 1,000 feet and 5,800 feet. He described the flight as a definite attempt to bring the British distance record back to Yorkshire.

Reprint from the Bradford Telegraph & Argus 21.5.79

EXPERIENCES IN BRAZIL

BY GRAHAM HOBSON

British flyers are certainly spreading their wings in a variety of different countries. Graham Hobson decided to escape the northern winter snows by spending some time in Southern California. He became involved with Bill Bennett and development of his latest gliders and was included in the Bennett team's trip to Brazil.

He describes here some of the differences between British hang gliding and that in Brazil and relates his experiences in Rio.



Until now I had never given much thought to the flyers in Brazil, expecting them to be rather inexperienced and disorganised. I felt that any opposition in the competition there would come from other invited foreign pilots.

I was soon to drop this misguided notion as it quickly became apparent that the Brazilians were a group of experienced and skilful pilots who fly up-to-date American and French gliders and attack their sport with characteristic Brazilian fervour . . .

Hang gliding in Brazil first took off over six years ago when a group of French flyers flew from one of the large cliffs that surround Rio. Exposure to the sport was increased when the American Rich Piccarilli flew from the famous statue of Christ on Cocobana and landed in the Jockey Club 780 metres below.

Since those days, the Associao Brasileira de Voo Livre based in Rio has grown into a 300 member body, controlling flying in the area. My host, Claudio Duvivier was one of the founder members (starting in July 1973 on an Eipper kit) and his wife Denise edits the club magazine.

In common with most Brazilian flyers, the Duvivier family are wealthy and I was wined and dined in unashamed luxury throughout my entire stay in their beautiful large Rio home where three servants and a cook catered for my every need.

There is a good reason for Brazilian flyers being wealthy: that is that only the wealthy can afford to pay a whopping 300 per cent duty on any imported luxury item — causing a 1000 dollar glider to cost 4000 dollars, which in turn leads to a roaring trade in black market gliders and hence problems with the customs.

The site for the competition was Pedra Bonita, which is a 2000ft. launch ramp perched above the jungle and bordered on either side by the characteristic vertical-sided rock towers of the Rio area — reaching well over 2,500ft. into the sky. These sheer but smooth rock faces held something of an awesome aspect as they stood in the strong tropical sun and, as we were to see later, they produced some fantastic lift — also allowing, on occasions, pilots to soar out to the beach, 3,000ft. above it.

The ramp itself was a marvellous affair being virtually wide enough to accommodate two gliders side by side, and unlike the ramp

on Lookout Mountain in Chattanooga, allowed self-launches even in wind.

A long way down, and about half a mile from take-off, was the landing area, which was Pepino Beach. It was here that Rich Grigsby taught me how to body surf between competition flights — the surf breaking on that beach was the biggest and best I have ever seen.

So, after seeing all this potential we returned to the airport to be greeted with the disappointing news that our gliders would not arrive in time for the competition. We had to start running around trying to borrow gliders and harnesses.



This was my downfall as far as the competition went because I was not able to borrow a suitable glider for the occasion. I also had to use a knee-hanger harness which wouldn't go prone. I had to hitch my legs on to the back wires! Against world class opposition this simply wasn't good enough and I was eliminated fairly early. I was able to sit back and enjoy everything and allow the competition to continue excitingly enough without the sole British entrant. (They raised a Union Jack just for me!).

In fact, the Frenchman Tevenat ended up in first place with Rich Grigsby in second and all the other placings were Brazilian. I think the glider and flyer that most impressed me was Tevenat on his French Atlas. That guy never loses; winning every heat and walking away with the championship.

I learned that he intends to come to the UK for one of the league events. So, here is a warning to league flyers — unless we want a Frenchman to win our league, we had better get practising.

Gliders present were mainly American Phoenix, Condors, Seagull and other floaters like Moyes — all suitable for the light coastal conditions and weak thermals that were predominant. The French Atlas was making its presence felt and one Gryphon flown by a Swiss flyer did not show off to its best advantage.

Although there is not much thermal activity on Pedra Bonita, due to stable marine air, the

flyers at Rio are able to experience good thermals at their favourite inland site three hours' drive away. This site, called Bocaina, is 1800 metres high, with a 14 kilometre ridge and porten potential for 100 kilometres. It is suitable for any wind direction, although north-west is best. With a road to the top and a safe landing top and bottom, it seems like a premier site. I'm told flyers have thermalled to 8000ft. there!

Back in Los Angeles I worked at the Bennett shop for another week. Then, thinking the British winter would be over, I hopped on to a plane and arrived home in time for the league and the good old British blow-out blues!



DROP OF THE HARD STUFF

Cold that weekend, I recall,
Even colder in the squall
Which, too gusty, grounded all
With an icy shower of rain.

Minutes later the wind once more
Smoothed out, just right to soar.
I took off but the lift seemed poor.
Bottom landings are a pain.

Along the ridge. The kite feels odd.
You're stalling this turn, you silly sod.
Won't stop turning. Oh my God!
Don't do that again.

Lost it. Landed. Checked around.
Brand new sail. The trouble's found.
The air was freezing near the ground;
New Dacron repels the rain;

So drops had frozen during the squall
On top of the sail. Though only small
They spoiled the flow and caused my stall
Made height hard to gain.

Peter Robinson

Sky a Safari

Fly next year's machine this year

Safari Winner of the 5th league, Graham Hobson — 17 miles. Over 18 months of intensive flying of the prototype "Safari" proved to us that we had a winner to follow "Sunspot" and it is now in production. For light winds the medium "Safari" has the min. sink performance to equal the large "Sunspot" and that is saying something. It also has the penetration for strong winds and positive, predictable handling

with immediate response which is so necessary for all kinds of flying.

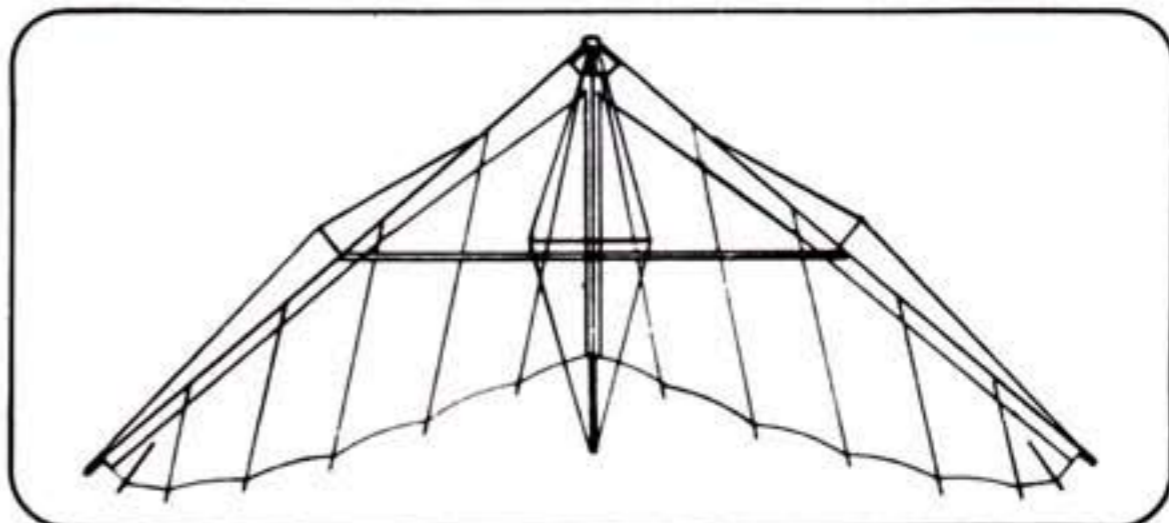
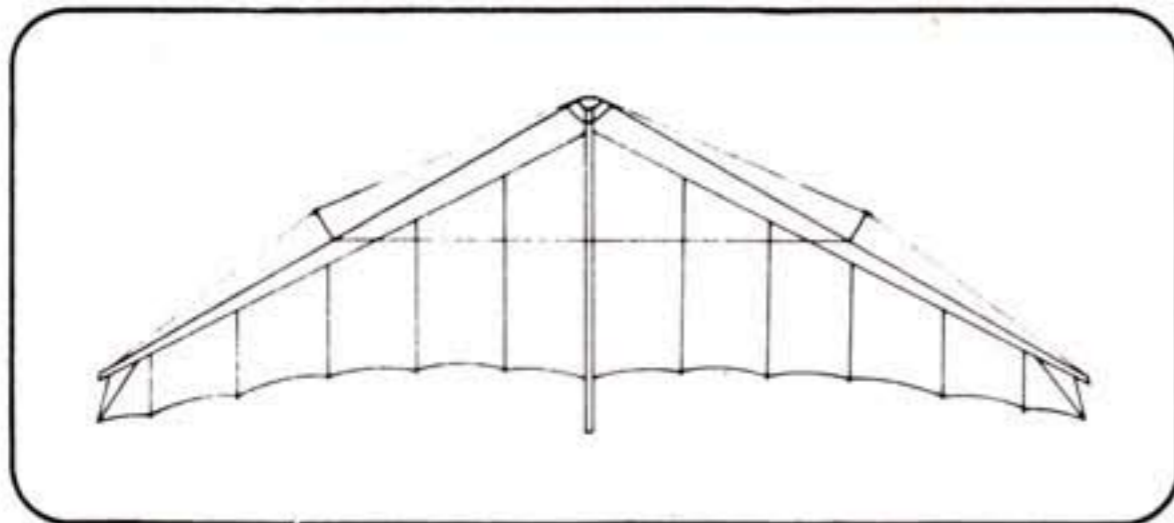
Glide angle at speed is good. The reflexed preformed battens in every seam make the whole wing pitch positive without the need for locked up tips etc. Vertical dive recovery is positive.

Safari is a real cross-country machine which easily makes use of thermals and handles the strong turbulence which often goes with them.

For the experienced pilot who demands the best performance but still wants outstandingly good handling.

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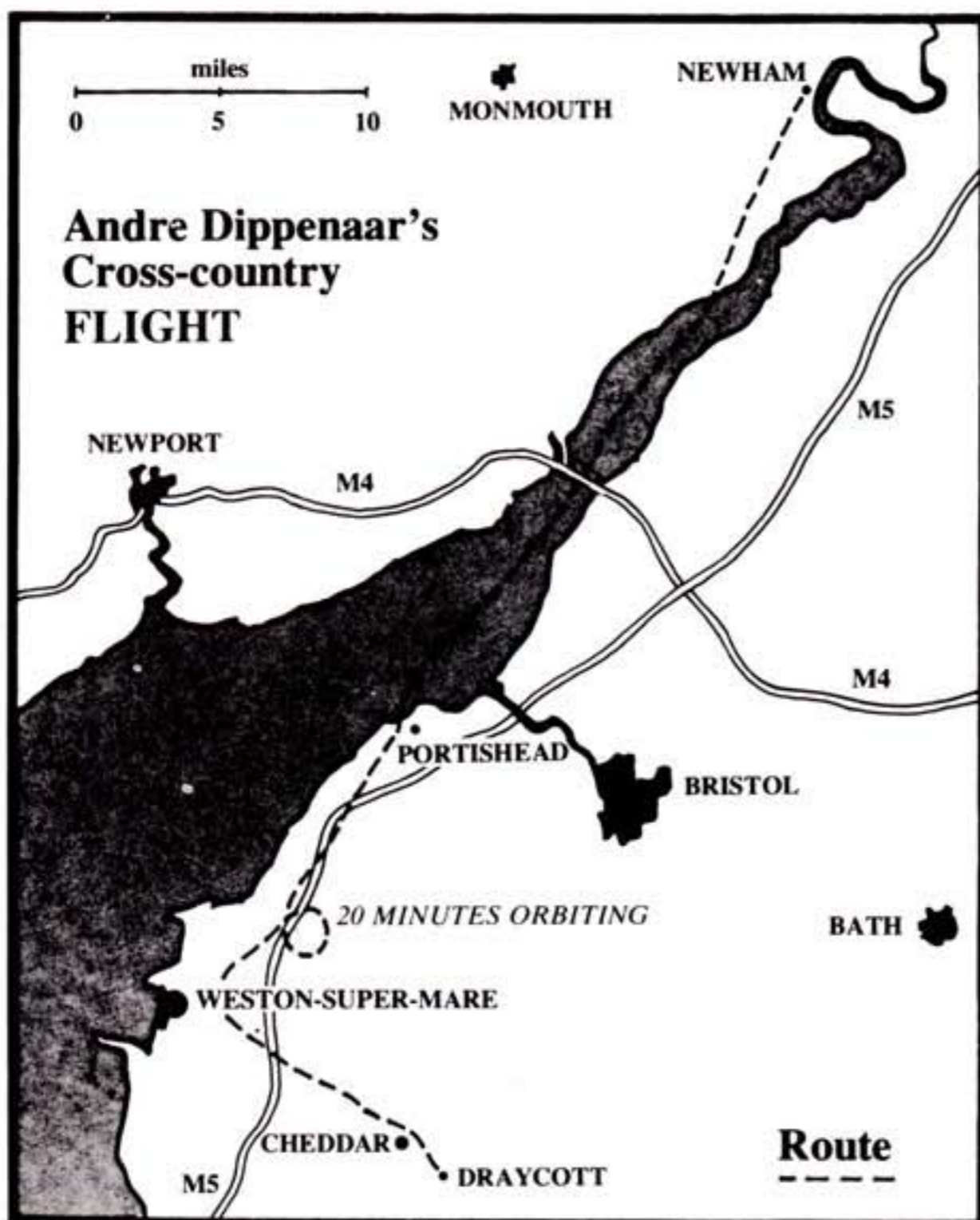
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THE SKY BICYCLE

BY ANDRE DIPPENAAR

There was the day at Taunton race-course when I flew in formation with an ex-World War Piper Cub. Its stalling speed is only about 26mph. A dog fight between an aeroplane and a powered hang glider is a bit unfair though. He had the speed and power to out-perform me by far — but with my manoeuvrability, I could shake him off time and time again . . .

Andre Dippenaar has been flying a powered hang glider combination since last November. He has logged over 10 hours flying time on the Johannesburg designed and manufactured Tornado combined with a Wayfarer 89cc 8hp unit. He describes some of his experiences here.



Combining power with good solid ridge lift can be very exciting. On one occasion at Cheddar I shot up to a dizzy height in only a few minutes using a moderate southerly blowing up the Mendips. As I had neither vario nor altimeter, I cannot make any claims. People disappeared though, and I could just make out cars on the roads. The two distant ridges to the south west could only have been the Quantocks and North Hill, Minehead. I could clearly see the Bristol Channel with Cardiff and Newport. A big cumulus cloud looks so much nicer from the top than from the bottom!

We had been planning a cross-country flight for some time, but the good English weather just wouldn't allow it. On Good Friday, April 13th, the wind was southerly and very light. I took off from level ground on the Mendips, just above Draycott, about three miles east of Cheddar, with just over a gallon of two-star in the tank.

I flew into wind and picked up lift off the ridge, but was soon limited by cloud at about two grand. I had only essential instruments for such a flight — a watch and a compass. I flew westward over Cheddar and then on to Weston-Super-Mare to stay well clear of Lulsgate airport.

I wasted about 20 minutes circling the intersection on the M5 serving Weston, mistaking it for the Clevedon intersection where I was to re-establish contact with the recovery car. Then I turned north along the M5, but at that altitude the wind was not as strong as I had hoped for. I was only keeping up with the slower traffic on the motorway. I left the coast at Portishead and flew out over the Bristol Channel to avoid Filton airport.

Then I flew straight up the Bristol Channel, where it was much smoother than overland. The Severn Bridge makes a lovely picture from above. Where the

Severn starts making horseshoe bends I turned left and headed for the Malverns, but then my watch said time was up. I knew from experience that I couldn't stay up for much longer than an hour and a half on a gallon of petrol.

I landed next to the A48, about nine miles from Gloucester. There was about a pint of fuel left. I phoned my recovery vehicle at the somewhat optimistic rendezvous point in Worcester. Had the cloud allowed me to fly higher in stronger wind and if I hadn't wasted 20 minutes over Weston, I might have made it through. Direct line from take-off to landing was 39 miles. The route over Cheddar and Weston came to 45 miles.

There was also the day at Wells . . . We had gone down to Cheddar again to soar the Mendips, as the forecast was south-westerly. When we got there the wind was south-east, which was along the ridge. I took off from a flat field down on the plains and a few miles west of Wells.

I knew there was a 'Siege of Wells' show on there that weekend and I headed towards town to see what was happening. Amongst all the excitement down below, I made out what looked like a fully rigged hang glider on the ground. I circled a few times and pressed on eastwards. But when the hang glider parted company with its shadow and started doing strange things, I turned back for another look. Later I learned that it was Gerry Breen on a Super Scorpion giving the locals a show!

In my opinion power makes a major contribution towards safety in hang gliding, if treated with the necessary respect. It makes it completely unnecessary to enter turbulent regions to hunt for lift. It allows you to circle an unknown landing area at low altitude to choose a suitable field. Boring soaring leads to daring aerobatics: the sky bicycle means going places.

TREDEGAR TO NORWICH OR BUST

**NARRATED BY
GERRY BREEN AND
STEVE HUNT**

GERRY

I have always been interested in flying and at first my passion was with sailplanes, although I hold a PPL and did quite a bit of powered flying too. I suppose I have always liked the ability to travel in powered aircraft and the skill and grace of gliding; so when hang gliders first appeared I built my own (from aluminium and polythene) and even then lightheartedly dreamed of one day flying a powered version.

That was all 7 years ago and what a lot has happened since! I have left the RAF and run a successful hang gliding school, the Welsh Hang Gliding Centre, and the sport has developed beyond recognition including the powered side — remember back-packs?

Early last year I ordered a Soarmaster power pack for my Oly 160 and the weeks passed slowly until it arrived in April. Excited and full of enthusiasm, I started flying from local hills, gradually working towards flat land take-offs. Despite the fact that my previous powered flying experience in light aircraft was invaluable, (I dread the thought of pilots with only hang gliding experience going straight on to power with no help and advice), I did have an accident in which I lost a couple of toes! Due largely to over confidence, I tried a flat land, low wind take-off, tripped, let go of the control frame and the glider overtook me, prop slicing through my boot on the way!

Once recovered and flying again I was able to continue with my arrangements to cross the English Channel. There is no worse torture than having your foot swathed in bandages watching the weather become perfect and knowing that somebody else is planning the same flight.

Unfortunately I was literally pipped at the post. If my boat escort had arrived in time, we had arranged to fly simultaneously. As it was David Cooke was unable to wait and flew alone on his powered VJ 23.

Whilst all this was going on I was taking bookings for air displays and getting into trouble with the CAA for flying at them! As I became more experienced and demanded more from my equipment I decided that Birdman Sports Moonraker '78 would be a better glider under power. Luckily the glider required few mods so I went ahead and bought one. Although definitely better in control it was not as good for takeoffs and was difficult to make it load up on flat land take-offs. The result was that I had the feeling it was going to overtake me — and I had very vivid memories of what could happen!

While I was experimenting with the Moonraker there were new noises in the valleys of South Wales. Hiway Hang Gliders had taken over a huge new factory at Tredegar and their designer, Steve Hunt, had also been experimenting with powered hang gliders and he now takes up the narrative.





STEVE HUNT

I started dreaming of powering a hang glider when I was flying a standard, but a few calculations showed that one of the larger capacity VW's would just about make it stay up.

Anyway, Jan '77 arrived and our new production glider, the Scorpion, was giving excellent sink rate. New calculations showed me that with a reduction system and (foolish me) a ducted fan, I would have my long-dreamed-of powered hang glider. My initial layout was very similar to the Soarmaster in that the engine was forward of the control frame and the ducted fan behind the keel. At this time we knew nothing of the Soarmaster product, or many teething problems would have been solved easily.

The duct and fan were too heavy and at the back of the keel so the trusty MAC 101 needed to be too far forward necessitating a longer drive shaft; all extra weight. We didn't like noise so a decent silencer was fitted and the glider itself was no lightweight. All in all we had 100 lbs.

Weight was not the only problem; starting up produced shaft torsion problems and the whole unit would tear itself apart. After trying one-way drives we eventually used a centrifugal clutch out of a washing machine and had no further troubles.

This glider flew but we decided that we'd never get a better overall performance with a ducted fan than with a propeller so two decisions were made; fit a propeller and modify the engine to fit a Super Scorpion (you may remember the model from the American Cup). This gave instant success and in the summer of '78 many hours of enjoyable flying were had by about 28 different flyers.

We always had a 'right turn problem' and so over the winter of '78/'79 we built a new unit and made it so that with only minor modifications it could be fitted either side of the glider. Accurate aligning of the propeller with the incident air-flow and a demon tweak involving one piece of wire produced a small piece of aerial magic; a powered rogallo with stable flight characteristics, light roll as on the unpowered version, (unlike most other powered rogallios) and most of all it is not tiring to fly.

Having flown some of the combinations along the way thus helping development to go much faster, the minute Gerry flew the final version he securely shackled it to his person and stopped flying all other powered hang gliders.

GERRY

I gave the new Super Scorpion a thorough test with a 55 mile flight from a display in Wells (Somerset) back to Steve's house near Abergavenny), crossing the Bristol Channel for the second time on the way. (The first time was last year as a publicity stunt).

As I am planning to fly from London to Paris the French Authorities have insisted that the hang glider is registered. Once the CAA knew that it was for a special reason and satisfied themselves that the Super Scorpion and power unit were built satisfactorily they complied and issued it with the registration G — BGNL.

The idea to attempt the world distance record was not really considered until my sponsors asked me to make a 'spectacular flight from their branch near Shrewsbury. As there is no suitable stretch of water to be crossed, (I had previously flown the Solent for the benefit of the Southampton branch), or other obstacle, the idea for an attempt on the world record was hatched.

As I had to make the flight from a particular area on a specific day I just had to wait and see what the wind direction was at the time and head off in the appropriate direction. Hence I was not taking the flight too seriously. I knew I had a good chance of breaking my own British and European distance record of 55 miles, so the take-off really was just a huge publicity exercise for Carrefour (a Hypermarket chain). From their point of view it paid off!!!

As for me? The wind was SSW so I was heading for York and beyond. If all went well I would run out of land at Middlesborough which would give me a flight of about 130 miles. Once airborne I realised that the wind at higher altitudes was more SW and changed my flight plan accordingly — I was now aiming for Hull.

Engine trouble developed about 10 miles after take off. I soon worked out that it needed re-tuning and did so by standing in the control frame! Otherwise the flight was fairly uneventful until 10 miles west of Scunthorpe, where I flew down to check my position from the motorway signs — they are nice and big! The engine shuddered violently and I had to land in a field close to the motor way. Had I beaten, equalled or fallen short of the record? All I knew was that it was very close. A phone call to say where I was and an hour later Lindsay, my wife, arrived to help de-rig and start the journey home.

She brought the bad news that I had covered 97 miles, just 4 short.

Dejected but not beaten we spent the return journey listing faults, comments and ideas in order to make a much longer flight. Initially I decided on 150 miles with the facility to go on to 200 if conditions were suitable. After looking at maps a few days later and discussing the flight with Steve I decided to declare my goal, wait for a strong WSW wind and try for Norwich airport 202 miles from the intended take off point at Abertysswg. Steve now had to work quickly to repair and improve the engine — the weather might be ideal next week, perhaps even sooner!!!

I'll leave Steve to explain exactly what was wrong and how he solved the problem.

STEVE

The whole crux of the trouble was vibration over a long period and the resultant damage was as follows:

The drive shaft was rivetted to collars and plates at either end of the motor. One line of rivets fractured allowing the shaft to move forward a little. The large tooth belt pulley then rubbed against the exhaust system and it still didn't stop running. Severe vibrations then loosened the pulley mounting bolt which eventually fell out and the engine stopped driving the propeller.

I replaced the rivets with cap screws and likely bolts were wired up. The old air filter was replaced with a foam McCulloch one that helped the engine run better. All bearings etc. were checked, even more petrol tanks were added and we thought we were ready for anything.

GERRY

But the weather wasn't. The engine was working once more and had been flight tested but the wind was totally wrong and stayed so for 3 weeks until May 7th, a Bank Holiday Monday. By this time I was so frustrated I had to fly — anywhere! The wind looked west so maps out to check where I could go. Unfortunately London, including Heathrow airport, is directly west of Tredegar so I had to console myself with a flight of about 70 or 80 miles and treat it as a proving run. I 'phoned the Met Office for a forecast; a strong south westerly right across the country, 30 kts. at 2,000 feet, so cancel the previous two sentences, ring Steve, also Jim and Chris, two instructors at the school.

Within ½ an hour I was at the hill with Chris rigging the Super Scorpion. Meanwhile Steve was phoning Norwich airport to advise them to expect me. He then made his way to Sywell airfield, (near Northampton). This was the make or break point at 110 miles. Once I had passed overhead he would calculate my ETA and forewarn Norwich and various media con acts. Lindsay and Chris were to follow me to Cheltenham as first-stage retrieve crew. Everybody was to ring Joan Hunt at 'mission control' for news and progress reports. She was busy notifying newspapers and keeping the television programmers informed.

At 11 am I was ready to go, with 4½ (Imperial) gallons in the tanks. The wind was straight from the SW, 20 gusting 30 mph. I knew the take-off would be difficult so waited for the best possible wind. At 11.19 I launched, the engine just ticking over. Going virtually straight up I opened the throttle. My map holder hit me in the face so whilst trying to hold it down I had to battle with fierce turbulence. It took a few minutes to gain sufficient height to turn with the wind and I was worried that it may be very unstable in the lee of the hill. I was also concerned about how and if I should navigate if the map should fall off — not ideal thoughts for the first few minutes of a 200 mile flight!

Once high enough I set cruise speed at 30 mph, turned with the wind and what a sensation, 0 to 60+ ground speed in 1 second!

I was able to settle down a little for the next two or three minutes I knew my route to Ross-on-Wye very well and hadn't even bothered with a map of this section. I was apprehensive about the turbulence I knew I would encounter behind the Blorenge (1,500ft) and about whether my parachute would do its job as well as its manufacturers claimed.

My fears were justified, I was repeatedly pitched down 30° — 40° and had to reduce power instantly to avoid inverting, and of course between being pointed down to the ground the glider returned to level flight and I had to increase power just as instantly to avoid losing too much height. On top of being flung about the engine started to play up just as it had on the flight to Scunthorpe so once again I was standing in the control frame, throttle in mouth, making mid-air adjustments to the main jet — "Gerry Breen, hang glider pilot and flying trapeze artiste"!! Soon sorted out, I concentrated on keeping the right track and returned to the hand throttle. I was not helped by the fact that there was slightly more south in the wind so I had a cross-wind component to contend with. My map was only 5 inches (20 miles) wide so I had to remain alert.

After experiencing bad sink just before Abergavenny and incredible lift and bumps on the other side, I was thrown off track once more, and I'm still only 7 miles from take off! Battling back on course brought home to me how much it could affect fuel economy if I had to do it too often.

The rest of the journey to Ross-on-Wye was bumpy but I was able to relax and reflect on what was happening. There I was, 2000 feet up, and on my way to the other side of the country on what suddenly seemed a very flimsy piece of machinery. Now I know how Lindbergh must have felt as he crossed the Atlantic coast on his way to Ireland via the frozen northern wastes.

By Ross-on-Wye I had solved the problem of my map holder, essential as I now had to navigate. The journey so far had taken 30 minutes. I had been careful to time it as I knew Ross was 30 miles from take off and wanted a good indication of my ground speed; conveniently 60 mph. From here on, I had marked my route at 5-mile intervals to help with navigation.

After making sure that it actually was Ross-on-Wye by identifying the start of the M50 and locating it on my map I set off on what was in many ways the journey proper. From now on I was kept busy navigating and trying to use fuel economically. By the time I reached Tewkesbury I was sure that my ground speed was less, about 50 mph, probably due to lower altitude and slightly lighter wind being in the shelter of the Black Mountains. I had a pocket Instamatic strung from the control frame, unfortunately being knocked about since I had removed an elastic from it to fix the map holder. I had already taken a witness shot of the glider on the hill before launch with various people in front of it; now I took a shot Tewkesbury complete with my wing tip in frame. Super fun taking photos whilst in a high bank turn! (I took more shots during the flight until at Peterborough I noticed that the film had fallen out!).

Off on course again I could see the Severn estuary way over to my right and the Black Mountains of home that had given me such a bumpy send-off looking very dark and dramatic on the horizon behind me.

Flying at approximately 1,500ft (wish I had an altimeter!) I approached two airfields, Honeybourne and Gaydon. Unsure whether they were active or not, I took the safest action and steered clear of control zones as I was flying at circuit height. I did see one aircraft on approach, otherwise surprisingly little activity. This made me think. Obviously Honeybourne was in use but I would have expected to see more aircraft on a Bank Holiday; I was soon convinced that the wind at

ground level was very strong and worried about landing if it was still strong when the time came to touch down. I decided that there was no point in worrying about it, I would just have to sort it out as it happened!

Passing Daventry I felt proud of my map reading — it was over 4 years since I'd done any true long distance navigation and all the old techniques were coming back. I knew as well that the next major landmark was Sywell where Steve would be waiting and the world record broken. My mind was wandering a lot now, I had lost altitude and wasted fuel climbing back up to 2,000ft for the approach to Sywell, and there it was ahead of me. But was it? No activity, no cars, no sign of life at all. A quick check with the map and I identified the road, lake and position of Northampton. Yes, it was definitely Sywell. In case Steve was about, and I think I caught a glimpse of his car, I did a few 360's and blipped the throttle to draw his attention, but there was still no Steve. Feeling bitterly disappointed, for I was really looking forward to seeing a friendly figure and sharing my elation, I plodded on.

With the 100-mile point well behind me I forgot all the niggles of the past 2 hours and relaxed. I left the compass to wander; I was very tired and hadn't the energy to correct a wing rising. I let gusts buffet me and just hoped that they would equal each other out. The countryside was levelling off and becoming sparse; and my decision not to fight gusts was a bad one — a town appeared ahead of me and I didn't have a clue which it was. I had to spend 5 minutes flying around comparing road systems and outlying villages before I knew for sure that it was Peterborough — 10 miles north of track. I knew I had to rejoin the correct flight path and that meant flying cross-wind. It was very hard work, my ground speed was reduced to 40/45 mph and by now navigation was like trying to pick my way across a patchwork quilt! Miles of flat dark fields interspersed by long straight roads, and absolutely no clear landmarks. The fields were either peat or burnt stubble and whatever they were they produced plenty of strong thermals making a choppy ride. Ground speed was also varying because of gusts and it may have been my imagination but I'm sure I heard the engine missing.

Once I was back on track my heart started to beat faster and sweat trickled down my back. Visibility was growing poor and freezing rain stung my face. I hoped that the engine wasn't affected by rain and kept checking the fuel line for air bubbles. If the engine had missed I would like to know the reason why; rural Norfolk is not the place to land out, being just about the most sparsely populated and sleepy outback of the UK. All the time it was getting darker and wetter. I kept looking at my watch and calculating when I might be able to see Norwich. I slowed down my airspeed to 25 mph and unrolled some more of my map, thinking that on any future flights I would mark it with distances from goal. But it didn't matter this time, there on the map was Swaffham and 20 miles beyond it, Norwich. The rain stopped! (Definitely a sign from someone higher up). I had two alternatives; I could stay at the same altitude and conserve fuel, or gradually descend and convert the difference in height to extra speed. I decided to stay where I was and use as little power as possible.

At Dereham I scanned the horizon for Norwich and could just discern it as a darker area. I followed the Dereham/Norwich road for some time and my heart beat faster again as I followed the compass setting eastwards (to compensate for a slight northerly drift), leaving the security of the road.

I just kept going until I could see the runway straight ahead of me and must have subconsciously been pulling on the bar because suddenly I was much lower than I should have been. Then the engine stopped. I couldn't believe that I wasn't going to make the airfield, but once the panic was

over I remembered that I had a good tail wind and started willing the glider towards the perimeter. I just made it (another sign?) and literally dropped onto the ground, going backwards at one stage. I was right about the strong winds but once down it was okay as the wind gradient was very pronounced. It was 15.17.

Well, I'd done it. 202 miles declared goal and nearly 4 hours flying; but not a very dramatic entrance. I was on the very opposite side of the airfield to the control tower and wasn't even sure if anybody had seen me land. I needn't have worried; very soon an airport vehicle was on its way out to me full of airport staff, and it was alright, they were expecting me. (I had thought of sneaking off in case Steve hadn't got me permission to land after all!). They were beaming their welcomes and congratulations followed very closely by another vehicle even fuller with press men and, thank goodness, members of the Norfolk Hang Gliding Club. But, I hadn't finished flying. Full of euphoria I made the foolish decision to fly again for the TV cameras who had not been able to film my landing. To my surprise the engine fired straight away, although the clutch did stick. That presented no problem as it just meant that the prop turned at the lowest of revs.

It was too bumpy for a good flight and although the take off was fast I was thrown around as if I was in a bottle of fizzy pop. I kept my altitude low and headed for the grass on the other side of the main runway. I didn't want to be thrown on to the concrete and end up with a broken kite and possibly a broken me. After cutting the engine and gliding in the landing was clean and the telly men were happy.

Now Greg Thomson and the Norfolk Hang Gliding Club came into their own and the matter was nicely taken out of my hands. The glider was carried over to the dispersal area, I was shepherded to the restaurant where I was brought coffee, food and a cigar, and could collapse. I started to feel cold; it must have been nervous energy that kept me so warm whilst flying. The whole situation became dreamlike, had I really just flown from Wales right across England? Sitting back in deep contemplation I thought — where is Steve?!!!

STEVE

Having driven for 3 hours across central England I arrived at Sywell airport, not sure because of the prevailing conditions whether Gerry had left. There was not an aircraft in sight. I opened a door at the base of the control tower and walked in: no-one about. Looking around the airfield there was only one chopper sitting behind a building and one aircraft securely tied down next to another, but not a soul anywhere. Eventually I phoned 'mission control' who reported that Gerry had taken off at 11.19. It was now 12.33 and he could pass at any time. I kept a close eye on the horizon to the WSW. Soon a helicopter pilot arrived. He said he was hoping the wind had dropped so that he could go home but the prevailing conditions, 25-30 knots, meant it was far too dangerous near the ground even in a chopper.

When I told him I was waiting for a friend to fly over in a powered hang glider on his way from Tredegar in South Wales to Norwich he looked at me disbelievingly and assured me that nothing was flying today, the air traffic controllers and the fire people having awarded themselves the day off. I would have liked to see his face when Gerry flew over but because of the distraction we missed him passing at 2,000ft doing 60 mph, and because of the severity of the conditions we didn't hear him either, and due to carelessness we failed to pick out the small red, white and blue dot as it floated overhead.

Still, I had a control tower all of my own so a direct line to the RAF radar station got the reply "We have a very small dot travelling 070 directly over the TV aerials at Peterborough". Back in business, the ground crew continued on its way now

sure Gerry would reach Norwich.

I arrived at the airport with the rain drizzling down and drove to the far end of the car park where I could get onto the apron. I looked for signs of activity, there it was, alone, cold and forlorn, a battered, dirty hang glider parked on the grass only a few yards from a gaggle of jets and shorthaul airliners.

The hero of the hour and all the local hang glider pilots were reclining in the restaurant, the pilot dead beat but elated and everyone was very happy. When I went in Gerry complained about one thing; that out in the elements, no sunshine, with rain pouring down "He'd been too hot!" Serves him right for buying too many Arctic thermal suits!!!

We ended up eating a late lunch (7 pm) and headed back home. 5 hours later we were back in South Wales, to be greeted by a cracking party. Only at the end of it was it possible to see the day's events in perspective.

We'd spent months working on powered rogals, both in our separate ways trying to improve the breed. After those hundreds of hours of work Gerry spent 4 hours flying 202 miles using 3 gallons of petrol. On the ground I spent 15 hours driving 450 miles and used 25 gallons of petrol; and why did we do it? Because we both believed that this, the simplest of aircraft, (which can't even launch reliably from flat ground in a reasonable range of

conditions), could with drive and determination fly as far as one wants it to. Only with proving flights like this will we come up with a thoroughly reliable aircraft that pilots can fly for fun in a fair range of conditions without overtiring.

GERRY'S FINAL THOUGHTS

I wish I had remembered my altimeter and connected my helmet to a special system which had had hours of design time invested in it to help take the weight of my head!

I should have remembered Murphy's Law and made sure before take-off that Steve had got landing permission from Norwich — it was a nasty niggle in the back of my mind for 4 hours, along with trying to remember what various coloured flares meant.

A much improved map holder needs to be designed.

I was thirsty.

All long distance harnesses should incorporate a latrine!

There are many more smaller details all of which will improve conditions when I make my 500 mile flight later this year!

It is regrettable to have to end on a serious note but with the news of yet another serious powered hang gliding accident in the UK I do feel that it is necessary:

Powered hang gliding is not easy. Every pilot I know has had either a major incident or accident. Probably the biggest contributing factor is the popular belief that you can fly a powered hang glider when otherwise you would be grounded — that just is not true! If anything, it is more difficult to find suitable *safe* conditions because of the greater number of considerations.

Certainly in the UK and I suspect elsewhere, it will be a long time before powered hang gliders have reached a sufficiently high standard to be sold as they are at present; to any pilot with cash in hand, a power unit will not solve any inadequacies.

Gerry Breen and Steve Hunt May 1979

Gerry Breen, fourth from right, with Norfolk flyers after his flight



AIRWORTHINESS STANDARDS AND REQUIREMENTS FOR HANG GLIDERS

The need for immediate implementation of the airworthiness scheme was stressed at the AGM. Everyone realises the importance of it — but how many of us know exactly what it is?

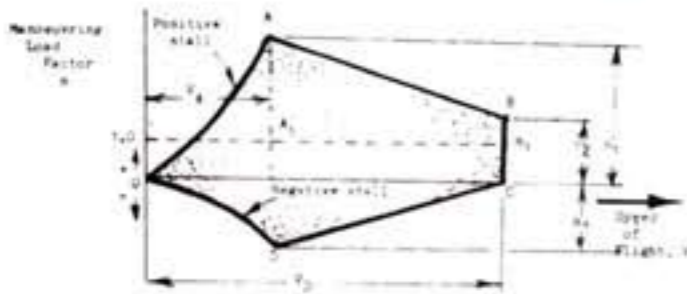
A document produced jointly by the BHGA and BHGMF under the authority of BHGA, outlines the standards and requirements involved. It is reproduced here so that pilots can see what airworthiness means.

SECTION A STANDARDS AND REQUIREMENTS

A1 FLIGHT MANOEUVRING LOADS

1.1 General:

The hang glider shall have proof and ultimate factors of not less than 1.0 and 1.5 under loads corresponding with all combinations of air speed and load factor on and within the boundary of the manoeuvring envelope of Fig. 1 (E3-2). In all cases the conditions represented by the points A, B, C and D shall be investigated. Investigation of intermediate points may be necessary if the hang glider is unconventional in layout or in construction.



Notes:

- (1) "Speed of Flight V" is the speed along the flight path expressed as (I.A.S.) Indicated Air Speed.
- (2) In the absence of better information, the maximum negative value of C_L may be taken as 0.8.

1.2 Manoeuvring load factors:

The value of n_1 , n_2 and n_3 shall be taken from the following table:-

Manoeuvring load factor	Normal (Utility) category
n_1	+4.0
n_2	+2.0
n_3	-2.0

1.3 Maximum pilot weight:

The maximum recommended pilot weight, w , shall be calculated as follows:-

$$w = 1.5 \times W_c \times n$$

where W = the gross weight carried

1.5 = the safety factor

c = airspeed factor

n = appropriate manoeuvring load factor (4.0 for hill/thermal soaring).

The airspeed factor, c , shall be taken as follows:-

Airspeed	Airspeed factor
10mph	1.1
20mph	1.0
30mph	0.9
40mph	0.8
50mph	0.7

For static conditions (airspeed = 0) the air-speed factor may be taken as 1.0.

- 1.4 The hang glider must be able to support the prescribed ultimate loads without permanent deformation.

A2 MATERIAL STANDARDS AND CONSTRUCTION

Materials used in the primary structure shall conform to an acceptable material specification as defined from time to time in BHGMF Standards Manual.

2.1 Construction methods:

The methods of construction and attachment used in the primary structure shall be such as to produce a consistently sound structure, which shall be reliable in respect of maintenance of the original strength under reasonable service conditions. When methods of construction and attachment need close control to attain this objective the process shall be performed in accordance with a suitable process specification.

2.2 Locking of connections:

Satisfactory means of locking shall be provided on all connecting elements in the primary structure, control and other mechanical systems essential to safe operation.

2.3 Inspection provision:

Adequate means shall be provided to permit the examination of such parts of the hang glider as may require periodic maintenance.

2.4 Rigging:

It shall be easy to inspect the hang glider to ensure that it is correctly rigged.

2.5 Ground handling:

The design of the hang glider shall be such that normal ground handling shall not result in damage or maladjustment of the aircraft.

A3 PERFORMANCE

- 3.1 The best glide angle must not be less than 1:3.

- 3.2 The glider must be capable of sustained soaring flight in a wind of not more than 18mph.

A4 FLYING REQUIREMENTS

4.1 Take off and landing:

The glider must take off and land under control without special pilot skills being required within the recommended operational wind speed limits.

4.2 Speed Range:

The glider must be capable of reaching a speed of not less than 30mph when the flight speed is steadily increased from minimum sink speed. The stall speed or minimum controllable flying speed must not exceed 20mph airspeed.

4.3 Pitch stability:

The glider must be able to fly hands off at a stable speed without pitching in smooth air. This speed must approximate to normal glide speed (between stall speed and 130% of stall speed).

The glider shall have positive static longitudinal stability at all speeds between minimum speed in steady and stalled flight and the maximum speed appropriate to the hang glider.

As the speed increases or decreases a corresponding increasing movement and force shall be necessary on the controls.

Within the speed range (i.e. all speeds at and above the stall speed to the speed which may be achieved by pulling forward from normal glide) the glider will return to the normal glide speed in a well damped manner when the control force is steadily relaxed.

4.4 Yaw and roll stability:

Lateral trim shall be such that there is no tendency for the glider to bank, turn or yaw when, with the glider in straight flight, all pressure on the control is released. Any oscillation following centralisation of the roll control shall be well damped.

The glider shall not exhibit excessive slip or skid tendencies when a smooth turn of at least 30 degrees bank is reversed.

The glider shall roll out to level flight when the pilot re-centres after a smooth banked turn of not less than 30 degrees without oscillation in roll or yaw, or any unusual skid tendency.

4.5 Circling:

In steady turning flight the corrective control force or movement required to stabilise the rate of turn shall be small.

4.6 Stall characteristics and behaviour at slow speed:

At the stall and in the approach to the stall in straight and level flight there shall be no violent wing dropping and no uncontrollable tendency to spin. In a turn of 20 degree bank it must be possible to recover normal gliding flight without excessive loss of height, adverse yaw or uncontrollable tendency to spin.

4.7 Spinning:

If a hang glider is capable of spinning, it must be recoverable in not more than 1.5 turns by normal control methods.

4.8 Behaviour as high speed:

At full dive speed (flying prone) the glider must not exhibit any uncontrollable tendency to oscillate in roll, pitch or yaw. There shall be

no snatching or excessive movement of any control surfaces. It must be possible to maintain control without excessive force.

4.9 Configuration stability:

There shall be no feature in the design or configuration that causes the hang glider to show any tendency to tuck under, to lock into a luffed dive or a turn, or develop any other unsafe characteristics.

SECTION B TEST METHODS

B1 STRUCTURAL TEST METHODS

A representative model of each hang glider type shall be load tested before application for approval. Load tests shall determine the maximum safe pilot weight for each production machine type.

All tests shall be fully documented. Test records shall include signed and witnessed statements, together with photographs of a production model in flight carrying its ultimate load suspended from the normal pilot hang system. All documentary evidence of tests must be retained by the manufacturer for presentation with the application for approval.

In dynamic tests the glider will be deemed to be in flight merely by achieving unsupported ground clearance. This may be achieved by any means, including free flying, towing or dropping, provided that any attachment is included and clearly visible in the photographs taken at the time of testing and can be seen not to be supporting the glider or relieving stress on the glider in any way during the test. The airspeed of the glider shall also be recorded and documented at the time the photo is taken.

In the event of structural failure occurring during a test, the gross weight must be calculated on the greatest weight carried without resulting in any structural failure in flight.

B2 FLIGHT EVALUATION METHODS

2.1 General:

All flight testing shall be adequately logged and documented. Other supporting evidence (such as cine film, photographic stills and statements) shall be retained by the manufacturer and must be provided with the application for approval. Separate tests are required for seated and prone if both pilot positions are recommended for the glider.

2.2 Flight tests:

2.2.1 Take off and landing:

It shall be demonstrated that, within the pilot skill grade recommended for that aircraft, the glider will take off and land under control, without special pilot skills at wind speeds:-

- within 5mph of the recommended minimum wind speed.
- not less than the recommended maximum wind speed.

2.2.2 Speed range:

- With the glider carrying a load which does not exceed the minimum recommended weight the glider airspeed shall be increased steadily from minimum sink speed to a speed of not less than 30mph.
- With the glider carrying a load not less than the maximum recommended weight the glider airspeed shall be steadily reduced until the onset of stall or minimum controllable flying speed is attained. This airspeed must not exceed 20mph and shall be recorded.
- In (a) and (b) the method of measuring airspeed and pilot weight must be recorded.

2.2.3 Pitch stability, trim and control:

Longitudinal trim:

- The glider shall be flown "hands off" at a stable speed without control application in smooth air for a period not less than 30 seconds. This speed must approximate to normal glide speed (between stall speed and 130% of stall speed) and shall be recorded.
- Pilot weight for this test shall be within the recommended weight limits.

Static longitudinal stability and control:

- It shall be verified that as airspeed steadily increases or decreases above or below normal "hands off" glide speed, corresponding increase in control force shall be necessary.
- The airspeed must return to normal "hands off" glide speed when the control force is steadily reduced at any speed above or below normal glide speed.

Dynamic longitudinal stability:

The glider shall be flown at twice the stall speed (or maximum speed if this is less) and the control force removed. The glider shall return to normal level flight without undue pitch, oscillation or stalling, or other undesirable characteristic.

2.2.4 Yaw and roll stability, trim and control:

Lateral trim:

The glider shall be flown at the "hands off" speed determined by test 2.2.3 (a) and the controls released. It shall be verified that the glider shows no tendency to bank, turn or yaw.

The glider should be flown from a 30 degree smoothly banked turn in one direction and then reversed to a 30 degree banked turn in the other direction. The glider shall exhibit no excessive slip, skid or pitch tendency.

Lateral control:

The glider shall be flown through a smoothly banked turn of not less than 30 degree of bank. It shall be verified that the glider does not exhibit excessive slip or skid tendencies and that the glider rolls out to level flight when the controls are returned to the central position.

2.2.5 Circling characteristics:

It shall be verified that in steady turning flight the corrective control force or movement required to stabilize the rate of turn shall be small. The pilot must report on the magnitude and direction of control forces.

2.2.6 Stall characteristics and behaviour at low speed:

- The glider shall be flown in straight and level flight at the minimum sink airspeed and the minimum recommended pilot weight.
- The airspeed shall be steadily reduced until stall speed is attained; at this point it shall be verified that there is no violent wing dropping or tendency to spin.
- The above test (b) shall be repeated in a steady 20 degree banked turn when it shall be verified that normal gliding flight may be recovered without excessive loss of height, adverse yaw or any uncontrollable tendency to spin.

2.2.7 Spinning characteristics:

If any tendency to spinning occurs in tests 2.2.6 above, then it shall be verified that recovery from a spin to normal gliding flight can be achieved within 1.5 turns or less by the use of normal control methods.

2.2.8 Behaviour at high speed:

- With the glider carrying the maximum re-

commended load, the airspeed shall be increased and maintained at 2.5 times the stall speed, if possible.

- It shall be verified that the glider does not exhibit any excessive oscillation in roll, pitch or yaw and that there is no snatching or excessive vibration of any control surface.
- It shall be verified that control can be maintained without excessive control force or movement.

SECTION C DEFINITIONS

C1 GENERAL

1.1 APPLICANT

A person applying for approval of a hang glider or any part thereof.

1.2 APPROVED

Accepted by the Authority as suitable for a particular purpose.

1.3 AUTHORITY

For the purposes of this document, the Authority is deemed to be the **BRITISH HANG GLIDING ASSOCIATION**.

1.4 CONFIGURATION (hang glider)

A term referring to the aerodynamic characteristics of the hang glider (e.g. wing, added surfaces, pilot position).

1.5 HANG GLIDER

An aircraft, capable of being foot launched by the pilot and less than 150lb empty weight.

1.6 STANDARD MEAN CHORD

The length of the standard (or geometric) mean chord is given by the DESIGN WING AREA divided by the SPAN. The standard mean chord is located in terms of the coordinates of its quarter chord point and its inclination, both measured with respect to the standard aerodynamic axes.

C2 WEIGHTS

2.1 MAXIMUM WEIGHT

The maximum weight at which the hang glider is suitable for operation.

2.2 MINIMUM WEIGHT

The minimum weight at which the hang glider is suitable for operation.

2.3 WEIGHT EMPTY

The weight of the hang glider excluding the weight of the occupants, parachutes and other easily removable items of load.

2.4 DESIGN MAXIMUM WEIGHT

The maximum weight at which compliance is shown with the structural requirements.

2.5 DESIGN MINIMUM WEIGHT

The minimum hang glider weight at which compliance is shown with the requirements.

C3 SPEEDS

3.1 T.A.S.

The true airspeed of the hang glider relative to undisturbed air.

3.2 I.A.S.

Indicated airspeed. The readings of the airspeed indicator as installed in the hang glider, (corrected for instrument error but without correction for airspeed indicator system errors.).

3.3 V_A

The design manoeuvring speed, I.A.S.

3.4 V_D

The design dive speed, I.A.S.

3.5 V_{DF}

The demonstrated flight diving speed, T.A.S. for flight requirements, I.A.S. for operating limitations.

3.6 V_{NE}
The never-exceed speed, I.A.S.

3.7 V_S
A stalling speed (or, if no stalling speed is obtainable, the minimum steady flight speed) in straight flight with the glider in the configuration appropriate to the case under consideration, I.A.S. for structural and flight requirements.

3.8 **TERMINAL VELOCITY**
The maximum speed obtainable in diving flight.

C4 STRUCTURAL

4.1 **PRIMARY STRUCTURE**
Those portions of the hang glider, the failure of which would seriously endanger the hang glider.

4.2 **PROOF LOAD**
The prescribed externally-applied load, multiplied by the proof factor (normally 1.0).

4.3 **ULTIMATE LOAD**
The prescribed externally-applied load, multiplied by the ultimate factor (normally 1.5).

4.4 **LOAD FACTOR**
The ratio of a prescribed load to the total weight of the hang glider; the prescribed load may be expressed in terms of any of the following aerodynamic forces, inertia forces, or ground reactions.

4.5 **MANOEUVRING LOAD FACTOR, n**
The total aerodynamic lift on the hang glider, acting perpendicularly to the flight path, divided by the total weight of the hang glider.

Note:

In straight, steady flight, this load factor is equal to 1.0.

SECTION D DOCUMENTATION

D1 GENERAL

Documentary evidence of flight tests should be provided as follows:-

- 1.1 **Take off and landing:**
 - (a) Wind speed at take off and landing for both flights.
 - (b) Wind speed measurement equipment used.
- 1.2 **Speed range:**
 - (a) Pilot's weight.
 - (b) I.A.S. attained and methods of measurements.
- 1.3 **Dynamic longitudinal stability:**
 - (a) Pilot's weight.
 - (b) I.A.S. attained and method of measurement.
 - (c) Comments on positive pitch stability.
 - (d) Related control bar pressures and position.
- 1.4 **Yaw and roll stability — lateral control:**
 - (a) Comments on roll, yaw and pitch stability.
 - (b) Comments on related control bar pressures and position.
- 1.5 **Circling characteristics:**
 - (a) Control movements required.
 - (b) Control forces required.
- 1.6 **Stall characteristics:**
 - (a) Degree of roll and yaw deviation.
 - (b) Related control bar pressures.
- 1.7 **Spinning characteristics:**
 - (a) Degree of roll, pitch and yaw deviation.
 - (b) Recovery procedure and related control bar pressure.
- 1.8 **Behaviour at high speed:**
 - (a) Comments on positive pitch stability.
 - (b) Related control bar pressures and positions at high speed.
- 2.1 **Copy of proposed instruction manual.**
- 2.2 **Three dimensional drawings and basic specifications of major components.**

D2 ADMINISTRATION OF AIRWORTHINESS SCHEME

- 2.1 A manufacturer submitting an application is to do so in triplicate using the following forms that are obtainable from the B.H.G.A.
- (a) SEC/AIRW 2
"Executive Application Document".
 - (b) SEC/AIRW 3
"Static Load Test Data Sheet".
 - (c) SEC/AIRW 4
"Flight Test Data Sheet".

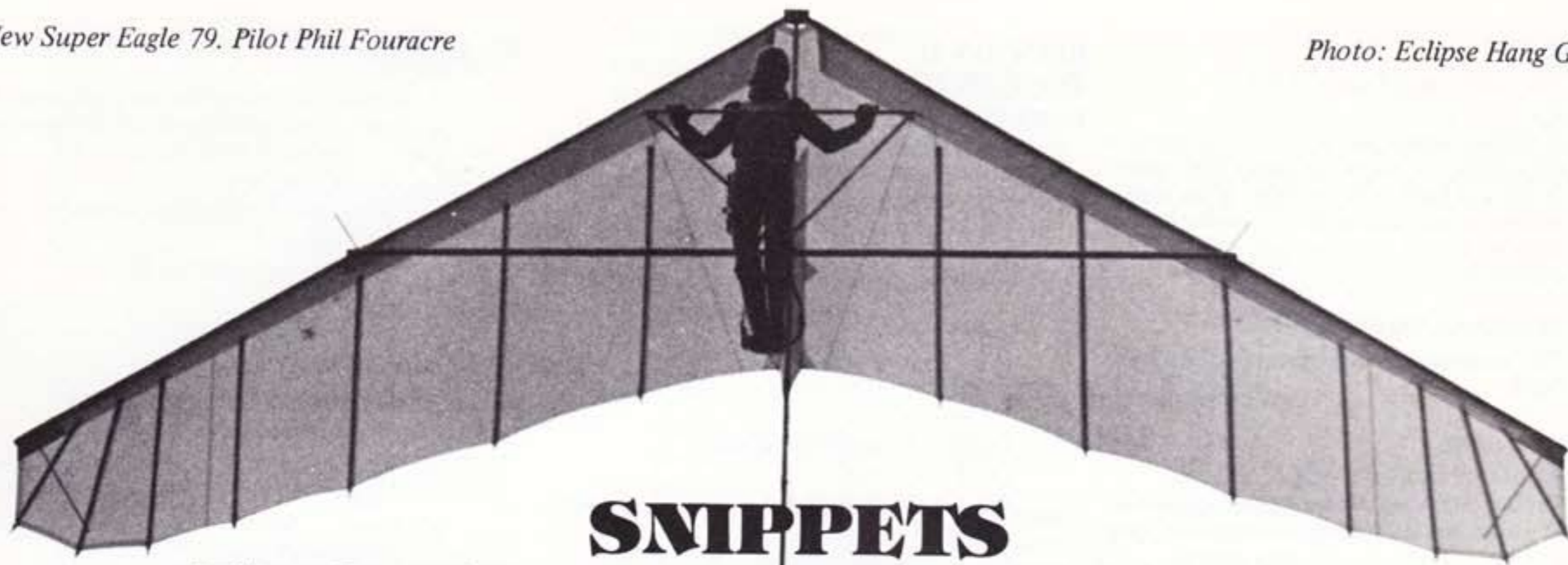
Triplicate copies of the following are required.

- (a) The proposed Instruction Manual.
- (b) The proposed Sales Literature.
- (c) Three view engineering drawings showing glider configuration and dimensions.
- (d) Basic Specifications of major components and all materials.

Applications should be made to the Secretary of the B.H.G.A. at Head Office. The triplicate sets of data should be accompanied by one set of any photographic or other supporting evidence.

- 2.2 Members of an Airworthiness Panel are responsible for vetting applications and will make their findings known to the B.H.G.A. Secretary. He will be able to issue a "Certificate of Airworthiness for Type" when members of the panel are satisfied that the glider meets the standards.
- 2.3 The Secretary will inform the manufacturer that a Certificate is available and will issue one on receipt of the appropriate fee.
- 2.4 A "Certificate of Airworthiness for Type" may be withdrawn if it is subsequently found that gliders manufactured to the design for that type do not meet "Airworthiness Standards and Requirements" for any reason.





SNIPPETS FROM THE MANUFACTURERS

THE CATTO

Pursuing their continued interest in powered hang-gliding, Scot-Kites are embarking on a test and evaluation programme on the Catto CA15 rigid wing. It is generally agreed that this type of rigid wing has significant stability and performance advantages over powered flex wings and tests in America have shown the Catto to have L/D 15:1, sink rate 150fpm, climb rate 425fpm. The Catto can also be flown as a foot launch engineless hang glider and with or without engine displays excellent cross-country thermalling potential. A Scot-Kites built demonstrator will soon be on display at various events and air shows.

Assembly from kit form is relatively simple and the structure features a unique cantilevered D-tube construction.

European assembly and marketing arrangements are being concluded. There is no connection with Electra-Flyer Corporation.

The Catto Aircraft



NEW SUPERSHIP

Bob England is seen here giving his new Gannet an airing at Pandy, the day after the joint cross-country record was achieved. The glider, designed by Bob, is to be produced.

For those interested in the technical details as at this early stage, they are as follows: area: 155sq.ft. span: 35.5ft. aspect ratio: 8:1 Root chord: 7ft. nose angle: 136 degrees.

The Gannet
Photos by Seaphot



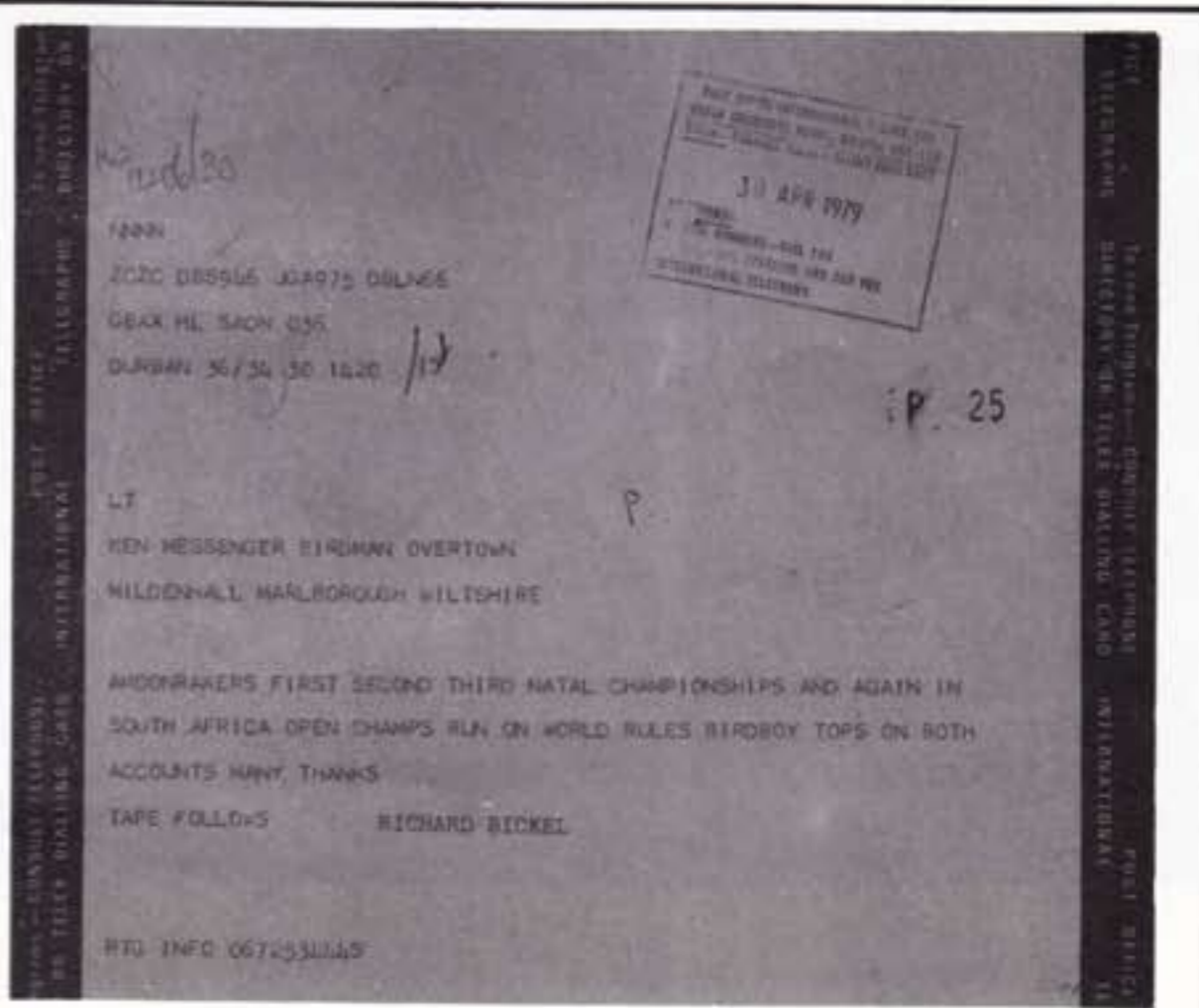
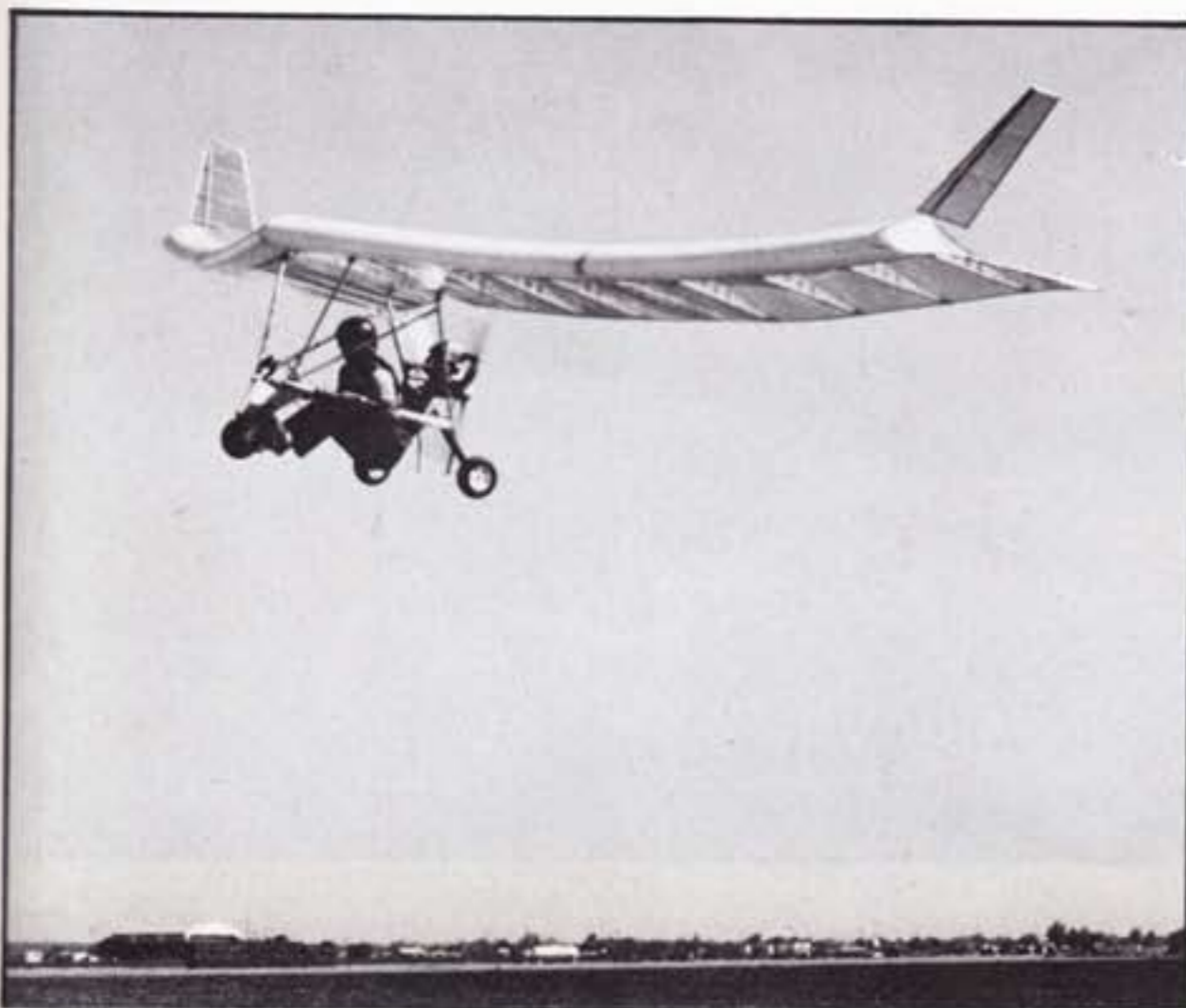
LEAGUE POPULARITY

Birdman report that the Cherokee is proving popular with league flyers — to the extent that there are more league pilots using that type of glider than any other make.

They have announced their list of league flyers which is as follows:

Mike Atkinson, Bob Bailey, Tony Beresford, Trevor Birkbeck, Roger Black, John Burgess, Lester Cruse, Ashley Doubtfire, Brian Edmeades, John Fack, Jan Ketelaar, Graham Leason, Mark Southall, Brian Wood.

They estimate that league pilots are distributed in the following way: Birdman 14; Hiway 11; Wasp 9; Skyhook 6; Chargus 4; Flexiform 3; Emu 2; Moyes 1.



TRAINING COLUMN

EFFICIENT TURNS

1. TURNS

(a) An accurate turn is a change of direction at constant rate, constant airspeed, and without slip or skid.

(b) In order to turn an aircraft it is necessary to provide a force acting upon it, in the direction which turn is intended. This can be done by banking the aircraft so that the lift, instead of acting vertically upwards, is now inclined towards the direction in which the turn is to be made. The vertical component of the lift will remain equal to the weight while the horizontal component will provide the necessary force to balance the centrifugal force acting outwards. The greater this inward force, the smaller the radius of the turn will be. Hence, if it is desired to turn sharply, the angle of bank must be greater than when turning gently.

(c) Since the lift must be sufficient both to support the aircraft and to provide the inward force, it must be greater than in straight flight. This increase in lift can only be achieved by increasing the airspeed or by some increase in the angle of attack, or both. Unless the airspeed is increased by the

pilot the angle of attack may be approach that of a stall.

This effect is not pronounced in medium and gentle turns, but becomes important in steep turns.

(d) When a Hang Glider is turning, the inner and outer wings travel on different paths and this causes two effects:

- i. the outer wing going faster than the inner tends to get more lift, and
- ii. the outer wing, travelling on a larger spiral is flying at a smaller angle of attack than the inner wing and so tends to get less lift. These two effects more or less cancel out each other, although on some high performance gliders the effect of the outer wing travelling faster is the greater, and so the angle of bank tends to increase. The important consideration is to keep the bank constant, weight shifting as necessary to achieve this.

FAULTS IN TURNS

(e) Bank should be held constant throughout the turn. At about 30 degrees few faults are likely to occur. Too little bank will result only in too

little turn, but increasing bank will result in steepening turn, which may get out of hand.

The nose may rise above or fall below the horizon: this is corrected by use of pitch.

(f) If the glider is slipping in it can be felt by the pilot tending to slip inwards; this is corrected by reducing bank and/or more pitch.

STEEP TURNS

(g) Although a steep turn is only an ordinary turn made much more rapidly, it is an extremely good exercise for improving a pilot's flying, and satisfying when it is well done.

(h) When making a steep turn, the lift on the wings has to be increased considerably compared to that in straight flight; the stalling speed is therefore greater, as is shown in the following table:

Angle of Bank	g.	Stalling speed × stalling speed in straight flight.
0°	1	1
10°	1.02	1.01
20°	1.06	1.03
30°	1.15	1.07
40°	1.3	1.14
50°	1.56	1.25
60°	2	1.41
70°	2.92	1.71
80°	5.75	2.4

(i) It will be noticed that above 60° the loads and hence the stalling speed, increase rapidly. It must be understood that it is impossible to do a continuous steady vertical banked turn since the lift of the wings, by acting horizontally, will have no vertical component to carry the weight of the Hang Glider.

(j) In order to develop the extra lift required it will normally be necessary to push out.

(k) The rate of descent in a really steep turn is rapid.

(l) If, when the speed builds up in a steep turn, the pilot attempts to reduce it by simply pushing out the bar, the Hang Glider will in consequence tighten up into a tighter spiral, and the speed, instead of being reduced, may even increase. Reduce bank before attempting to reduce speed.

(m) Keeping a good look out is important. It is not sufficient to look around before the turn and before coming out: even during the turn it is necessary to keep looking round and searching the sky for other aircraft.

**KEITH
COCKCROFT**

THE HERON THAT BAKED IT!

Have you ever seen a heron doing hoolies? Herons usually fly straight, and they leave our fish pond alone, because the spot landing would be too difficult. A couple of tiny gold fish would not be worth the risk of being decapitated on the clothes line.

"Look at that!" I said to Jean (I was taking her for a walk

down by the river in order to keep her sweet).

A heron had entered a radical, side-slipping 360. The bottom wing seemed to tuck. It paddled its feet, like a hang glider pilot in a near miss, and its head shot forward. It seemed a miracle that it recovered.

Then, either it was nerves, or sheer relief to still be alive, but it did a wingover. It went up to 90 degrees and held it for a second, under obvious strain, as its head went forward again,

and its feet once more began to paddle. It winged over the other way, did another side-slipping 360. This one was more controlled. It did two more wingovers, came into land — beside the female it was showing off to.

That was where it made its error. She was sitting in a rotor from some trees. There was no way our male hero could burn all his terrific speed, although flared right out and flapping madly. He had decided on a fast landing in order to impress

her, and was not going to admit defeat.

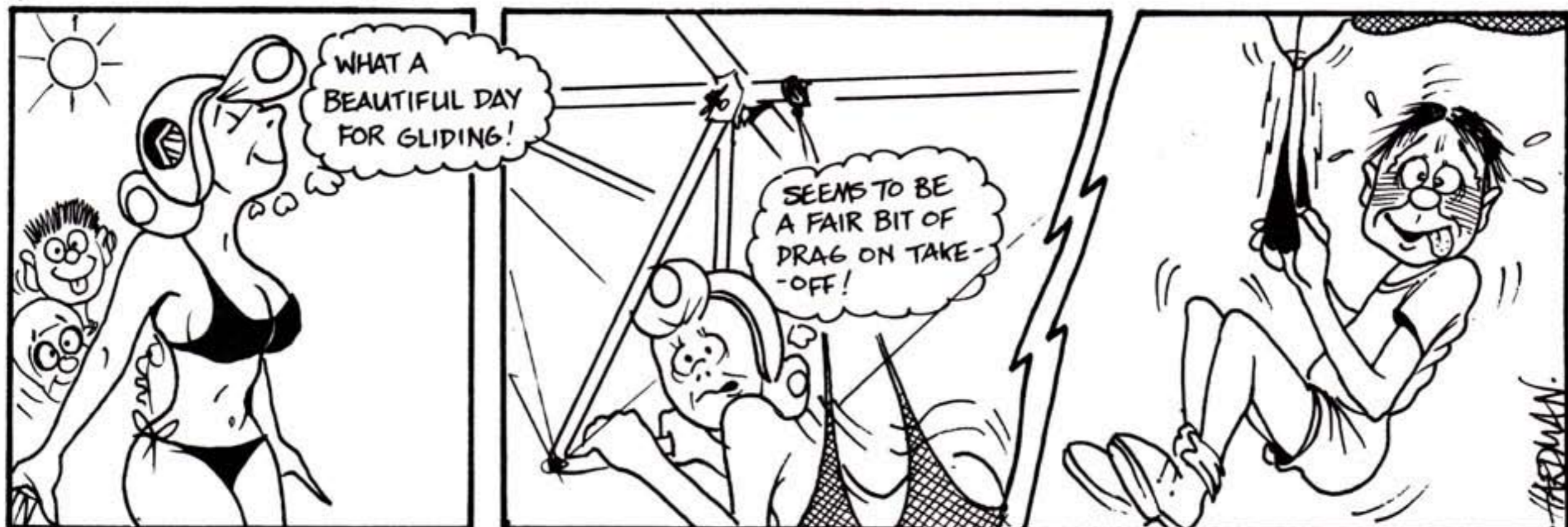
Overshooting by about ten feet, he got his feet down, tumbled forward, still flapping, tripped and went flat in the mud.

The female continued looking out for fish, pretending not to know him.

MORAL: If you are not in complete emotional control, and you cannot fly better than a heron, leave your bird at home when you go off flying.

Barrie Annette

Peachy by HARDMAN



INFORMATION



Terry Aspinall & Derek More

MERE 1979 SEPT. 8th-9th

Keep this date free. The event will take place over the weekend 8th/9th September. Mere Carnival is on for the same weekend, with barbeque and usual festivities. Full details will appear in the next issue of *Wings!*

STOP PRESS

FLYING IN NORTH WALES

Pilots intending to fly in the N. Wales area should first contact Ken Prydderch on Gresford (097 883) 2065 or Diane Hanlon on 051 652 5918. If you intend flying mid-week you must contact R.A.F. Valley on Valley (0407) 2241 Ext. 487 (Flight Planning). Or Ext. 292 (Flight Briefing), preferably before 0730 so that R.A.F. Pilots can be briefed on your activities before they fly. If you telephone after 0730 military aircraft will be contacted by radio. The North Wales Club have gone to a lot of trouble to arrange this notification procedure and it is proving satisfactory. Please use it. Not using it could spoil negotiations taking place over the introduction of a national system on similar lines.

FOUND AT CARLTON BANK

Ladies Avia wristwatch with gold bracelet. This is believed to belong to the wife, or girlfriend of a pilot who flew with the North Yorkshire Sailing Club during the last week of August 1978. Incredibly, the watch has now turned up in good working order. Will the owner contact G.S. Stapleton, secretary of the club, telephone Eaglescliffe 780533.

WORLD CHAMPIONSHIPS — GRENOBLE, FRANCE

The British Team will be travelling to the French Alps by mini-bus and it looks as if there will be a few spare seats available. They leave Ramsgate on 25th July and return on 13th August — the cost per seat is £50 return including the carriage of a glider.

Accommodation at the other end is a little vague at present, but there are obviously camp sites available in Grenoble if all else fails. Luggage would be minimal in view of the limited space in the bus.

Anyone interested should telephone Derek Evans on Tunbridge Wells 36026. Names will be recorded on a first come, first served basis.

For those who may be interested in going to the Championships under their own steam, the competitions will take place between July 30th and August 12th. The usual camping guides will tell you where to camp, but for hotels or chalets, write to "Alptour, Avenue d'Innsbruck, 38029, Grenoble Cadex, France, mentioning the fact that you are attending the World Hang Gliding Championships.

MAN-MADE SITES

Several members have written since the BHGA was formed saying that they were trying to influence local mining or quarry officials to dump waste to form a hill that could be used for hang gliding. Di Spinks of the Eastern Region Sports Council recently told me that she had planned a landscaping project to build one, in Essex, when the District Council squashed the idea because a road ran along what would have been the bottom of the hill.

Tow launching will soon make flying possible almost anywhere but extra sites would be very useful for soaring on days without thermals and for training. We can expect a sites group or committee to become active in the near future. One of the things they ought to consider is how the ideal man-made site should be constructed.

If any organisation offers to build us a site what should we ask for? An L-shaped spine-backed ridge? A mole hill? If any member has ideas please let the Secretary have them so that they can be considered before we get any offers.

AMERICAN CUP T-SHIRTS

There are a few of these shirts left. They are white with a four colour design commemorating the British Team's win in 1978.

Sizes: 30in. 32in. 34in. (S), 38in.-40in. (L). Send £2.90 (inc. p&p) to: 167A, Cheddon Road, Taunton. Make cheques and Postal Orders payable to B.H.G.A.

PEAK HANG GLIDING CLUB

Oxleisure Farm site must not be used on Bank Holidays or Sundays. Chelmorton is being endangered by people not paying the farmer on all sites before flying. The farmer there is also concerned about people climbing over walls.

SOUTH WEST WALES HANG GLIDING CLUB

Rob Symberlist is no longer secretary. All enquiries should in future be addressed to Tony Fletcher, the new secretary, who can be contacted by phone at Aberdare 875630 (home) or 874221 (work). Tony's present address is 3 Whitcombe Street, Aberdare, Mid Glam., but he expects to move to Swansea area shortly.

CHANGE FOR DAVE

As from June 1979 Dave Simpson will no longer be associated with the Dunstable Hang Gliding School Ltd. He will be devoting his time to hang glider lifting and towing systems. He is currently working on parasailing lift systems.

THAMES VALLEY CLUB CHANGES

The Thames Valley Club has voted in new officers following its recent AGM. In addition to Roy Hill as President, the club will have the following officers for the coming year:- Chairman: Ron Jerome, 159 Fairford Road, Tilehurst, Reading. Tel: Reading 412857. Vice Chairman: Ken Barker, 9 Argyle Road, North Harrow. Tel: 01-427 3014. Treasurer: Jim Evans, 13 Gwynn Close, Tilehurst, Reading. Tel: 22034. Secretary, Bob Fisher, 120 Crescent Road, Reading. Tel: 864066. Safety Officer: John Wadsworth, 51 Donkin Hill, Reading. Tel: 471851. Technical Officer: Reg Latimer, 36 Weavers Close, Witney, Reading. Tel: 5205. Editor of Thames Valley magazine: Steve Pionk, 23 Whitmore Gardens, Kensal Rise, London. Tel: 01-969 2788.

PILOT RATING SCHEME

All documents have now been sent out under the new system. Anyone who has not received theirs should contact BHGA at the Taunton office.

Index of Articles Appearing in Wings! from January 1975 to December 1978

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33 Flight handbook for Rogallo sailwings (1st ed.) by John Forrest		78 That desire for wings "Air gunner"	2 75 11 G
Nick Regan	3 75 8 R	79 Thermals - higher up Ann Welch	12 75 17 T
34 Flight handbook for Rogallo sailwings (2nd ed.) by John Forrest		80 Thermals in slope lift Ann Welch	11 75 15 TF
Nick Regan	8 75 17 R	81 Thermal soaring and the Rogallo sailwing: a practical technique	
35 Flight report Brian Gaskin	1 75 7 F	Ian Grayland	12 75 16 TF
36 Flight without formulae by A.C. Kermode Tony Fuell	12 75 20 R	82 Transporting your kite Tony Maclaren	12 75 19 TS
37 Flying clothes, <i>Concerning the hidden dangers with</i>		83 Trimming a standard Rogallo for good speed control	
Keith Greenish and Murray Rose	8 75 18 AS	Geoff McBroom	8 75 13 TS
38 Flying prone Miles Handley	5 75 6 T	84 Turns, <i>The methods and dimensions of 360°</i> Bob Wills	7 75 13 TSF
39 Free flight hang gliding by John James Dave Tait	1 75 18 R	85 Tweetie mono hang glider Ron Wheeler	8 75 14 T
40 Free flight hang gliding by John James Nick Regan	2 75 25 R	86 Two-man prone soaring record at Rhossili Martin Farnham	3 75 7 F
41 Fulmar, <i>The birth of the</i> Brian Partington	8 75 16 T	87 VJ23, <i>50 m+ flight of the</i> Dave Cook	9 75 23 FC
42 Glide angle indicator, <i>A cheap</i> Don Watts	2 75 16 T	88 Warning, <i>A</i> Ken Fenard	4 75 5 F
43 Hair raising experience Mark Shuttleworth	12 75 10 FA	89 Was this you Dr. Tom Scott	11 75 10 AF
		90 Weltmeisterschaft im alpin-drachenflug Ann Welch	4 75 18 C
		91 Wife's lament, <i>A</i> Eileen Birch	7 75 10 G
		92 You asked for it Frank Bailey	6 75 13 T

1976

93	Accidents, <i>Recent</i> (Barbara Jones, Guy Twiss, Mike Leader) John Hunter	8 76 16 A
94	Accident Reports (Denys Irving, Anthony Jones, William Taylor) John Hunter	10 76 4 A
95	Aerial Photography Bill Arkle	9 76 14 GT
96	Air speed and structural failure John Lake	5 76 17 TS
97	Air speed indicators Miles Handley	2 76 12 S
98	Aluminium, <i>Understanding</i> John Hudson	8 76 19 TS
99	America the beautiful, Part 2 Malcolm Hawksworth	1 76 23 GF
100	"And now for something completely different" B.A. Clifton-Harvey	2 76 17 G
101	Birdman sports challenge trophy event - 1976 Tony Fuell	4 76 16 C
102	Bluebirds over the white cliffs of Dover Ted Battersea	3 76 8 F
103	British wings - 1 Hiway Steve Hunt	2 76 16 T
104	British wings - 2 The Miles wing Miles Handley	5 76 18 TF
105	British wings - 3 Wasp Falcon III Brian Woods	9 76 21 TF
106	Bulldog grips - if you use them, don't abuse them Ray Acott	6 76 20 TS
107	Can't see the Woods for the Short trees Brian Woods	11 76 27 GC
108	Cracked, <i>Are you</i> Jim Taggart	7 76 20 TS
109	Crash landing, lessons from others' misfortunes G.M. Yuill	12 76 20 AS
110	Dangerous? well is it Tony Fuell	10 76 3 AGS
111	Danish bacons...!, <i>News from the flying</i> Gunnar Kelsen	3 76 12 FG
112	Distance flying Ken Messenger	5 76 26 F
113	Duration record 30.7.1976, <i>Euro-British</i> Nick Gifford	11 76 11 F
114	Duration record Kev Jordan	11 76 12 F
115	Embassy national hang gliding championships - 1976 Tony Fuell	6 76 11 C
116	F.A.I., <i>An introduction to the</i> Martin Hunt	6 76 4 G
117	First flight, <i>My</i> Carolyn Hickman	7 76 11 F
118	Flyers or sods Alan Simpson	3 76 8 FG
119	Fly: The complete book of sky sailing by Rick Carrier Mike Adam and Tony Fuell	7 76 20 R
120	Gift of wings, <i>A</i> by Richard Bach Tony Fuell	7 76 21 R
121	Hang gliding by Bob MacKay Tony Fuell	7 76 21 R
122	High flying birds by Peter Cave Maureen Flitton	11 76 23 R
123	High voltage injuries Garth Thomas	4 76 26 S
124	Hot weather flying, <i>A hazard of</i> Dick Scates	9 76 13 S
125	Instruments in hang gliding, <i>A theoretical look at</i> Paul Bridges	11 76 15 T
126	Insurance, <i>Hang gliding</i> Reggie Spooner	8 76 33 G
127	Insurance, <i>Liability</i> Reggie Spooner	12 76 27 G
128	Kössen '76 Ann Welch	10 76 17 C
129	Kössen 1976 Derek Reynolds	10 76 16 C
130	Kössen, <i>Lords of</i> Alvin Russell	7 76 23 FC
131	L/D and sink rate Neil Moran	1 76 15 T
132	League, <i>The British hang gliding</i> Brian Milton	8 76 33 C
133	League, (report), <i>British hang gliding</i> Brian Milton	10 76 (enclosure) C
134	"Lie in" on Saturday, <i>A</i> Bob Bailey	9 76 12 F
135	Luffing dives Len Gabriels	2 76 15 T
136	Lugs, <i>Design of</i> Ted Shreeve	3 76 19 TS
137	Major soar to ground control Bob Wishart	4 76 8 FG
138	Manufacturers gusts Terry Haynes	9 76 20 TC
139	Mere '76 Dave Worth	10 76 7 C
140	Mere report '76 Brian Milton	10 76 10 C
141	Mile high, <i>A</i> Paul Maratos and Graham Hobson	10 76 19 F
142	Monaco, <i>Idyllic December days in</i> Jeannie Knight	2 76 11 F
143	Mountains, <i>I "eat" the</i> Johnny Carr	12 76 10 F
144	Mynd, <i>The magic of the</i> Alvin Russell	5 76 15 F
145	Nonk rubber, <i>The</i> John Hudson	11 76 21 TFS
146	Oirland, <i>When Oi go back across the sea to</i> Dave Raymond	10 76 15 FG
147	One weekend Dave Cook	1 76 8 FG
148	Opinion - on hang gliding in safety Nick Bishop	8 76 29 GS
149	Order in the air Freddy de Frias	12 76 23 FPS
150	Penguin book of kites, <i>The</i> , by David Pelham Nick Regan	11 76 24 R
151	Performance, <i>How's your</i> D.S. Bremner	8 76 22 T
152	Powered hang gliding, some information Nick Regan	12 76 8 TG
153	Power lines, <i>Mark Cherkas hits</i> A. Cherkas	1 76 7 AF
154	Pre-flight inspection Ted Shreeve	1 76 19 S
155	Rapist, <i>Gliders hunt</i> Reprint, Sydney Daily Telegraph	9 76 11 G
156	Regan began, <i>How</i> Dave Tait	1 76 20 G
157	Rhossili, <i>A thrill at</i> Rachel Wright	9 76 12 F
158	Riding high Paul Maratos and Graham Hobson	5 76 14 F
159	Safe hang gliding meet, <i>The basis for a</i> George Greger	4 76 24 CS
160	Sails, by Jeremy Howard-Williams Malcolm Mugridge	11 76 24 R
161	Schools: interim report Alvin Russell	9 76 18 B
162	Schools: recommendation following interim report by Alvin Russell from B.H.G.A. Council 22.8.76	9 76 18 B
163	Selsey birdman rally, <i>A competitor's view of the</i> Stewart "Ziggy" Hampton	12 76 19 CG
164	Selsey: is it possible Tommy Thomson	7 76 19 T

165	Selsey: yes it is! Mike Collis	12 76 18 TC
166	Services, <i>Hang gliding in the</i> Mike Collis	5 76 23 G
167	Silence, <i>The sound of</i> Paul Maratos	6 76 19 C
168	Snowdon, <i>Lords of</i> Will Mills et al.	7 76 22 F
169	Soar like an eagle - land like a turkey John Woods	7 76 15 FS
170	Soaring, <i>Minimum</i> Dave Cook	11 76 19 TF
171	South Africa, <i>Why we maybe shouldn't have to think about</i> Malcolm Hawksworth	12 76 4 CG
172	South Africa, <i>Why we should not go to</i> Brian Milton	11 76 4 CG
173	South African review Caroline and Mike de Glanville	5 76 8 FG
174	South west region hang gliding conference Malcolm Mugridge	9 76 11 M
175	Stirrup harnesses - a warning	4 76 26 SF
176	Sunseed Robert E. Trampenau	1 76 17 T
177	Swallowtail safari, <i>A</i> Simon Mitchell	8 76 8 F
178	Travel in style Terence Tempest	6 76 20 T
179	Valkyrie Bill Wolf	3 76 16 T
180	Were you as high as a kite Willard Harris	12 76 24 S
181	Windcraft, <i>Basic</i> by Alan Watts Malcolm Mugridge	11 76 24 R
182	Wired, <i>Getting it</i> Everard Cunion	8 76 26 TS

1977

183	Accidents Tony Fuell and John Hunter	8 77 31 AS
184	Accidents, <i>Recent</i> Tony Fuell and John Hunter	5 77 10 A
185	Accidents, <i>Recent</i> Tony Fuell and John Hunter	11 77 20 A
186	Accident report, Alvin Russell John Hunter	1 77 5 A
187	Aeroplane flies, <i>How an</i> (Shell film) Stuart Singleton	4 77 23 R
188	Aircraft apathy Malcolm Hawksworth	4 77 11 S
189	Airspeed indicator, <i>Audible</i> John Bourne	1 77 19 T
190	Alvin Russell Brian Milton	1 77 4 A
191	Ariba Tenerife Eileen Hudson	7 77 17 FG
192	Atmospheric stability and thermal activity Dave Roberts	2 77 15 T
193	Beautiful dream, <i>The</i> Dave Cook	9 77 9 G
194	Bible, <i>The hang gliders'</i> by Michael A. Markowski Tony Fuell	9 77 22 R
195	'Big double' (Pandy-Hay-Pandy) Bob Wishart	11 77 15 F
196	Big hills v small hills Tony Fuell	6 77 13 CF
197	Birds and fools fly by John Urmston Joan Hunt	2 77 29 R
198	Blobs and how to fly them Bob Calvert	6 77 17 FT
199	Bob Wills Malcolm and Pat Hawksworth	7 77 19 GA
200	Canary fits G.G. Williams	5 77 28 FG
201	Carlton Bank to Swinton Bob Bailey	11 77 18 F
202	Cliff flying Bob Bailey	7 77 23 F
203	Cliff take-off, <i>Just one way to prang a</i> Barrie Annette	10 77 11 SF
204	Channel crossing Brian Milton	8 77 26 F
205	Cold wind from the east Brian Milton	1 77 23 GC
206	Complete birdman, <i>The</i> by Peter Haining Alvin Harding	2 77 29 R
207	Control frames John Hudson	5 77 13 T
208	Deaths 1976-77, <i>Hang gliding</i> John Hunter and Tony Fuell	3 77 4 A
209	Dictionary of terms, <i>The beginners</i> Ian Trotter and Graham Hobson	8 77 10 TG
210	Distance trophy, <i>Welsh K.O.</i> Bob Mackay	1 77 12 C
211	Drag, <i>Getting into</i> Dave Simpson and Clive Smith	11 77 12 T
212	First time high Ann Welch	9 77 14 SG
213	Flight above 5000 ft Dunstan Hadley	9 77 20 S
214	Flight of fancy Dave Tait	1 77 16 G
215	Flying birds by David and Kate Urry Mike Hibbit	2 77 29 R
216	Float like a butterfly skim like a VJ23 Dr. Martin Pickford	9 77 18 FG
217	Grandfathers masters meet, 1977 Teri Hughes	12 77 20 C
218	Gryphon, <i>Me and my</i> Johnny Carr	7 77 10 F
219	Hang glider pilot by Ann Welch and Gerry Breen Tony Fuell	6 77 38 R
220	Hang gliding by Martin Hunt and David Hunn Tony Fuell	10 77 24 R
221	Hang gliding, <i>All about</i> (extract from 'Hang gliding') Brian Milton	8 77 16 G
222	Hang gliding disease, <i>The</i> Roy Hill	1 77 29 G
223	Hang gliding manual and log, <i>The</i> by Dan Poynter	1 77 25 R
224	Hang on for dear life Tony Fuell and John Hunter	12 77 18 SA
225	Hay Bluff to Pandy Ken Messenger	5 77 27 F
226	Hong Kong, <i>The man who went back to</i> Edmund Hui	12 77 15 FG
227	How does your glider compare Gerry Breen	4 77 12 FT
228	How to ruin your day John Hudson	9 77 21 S
229	Iceland, <i>Hang gliding in</i> Halfdan Ingolfsson	4 77 27 GF
230	Instruments on a budget Dave Weeks	11 77 22 TF
231	Interview: Bill Moyes Jeannie Knight	10 77 21 G
232	Interview: Bob Bailey, Graham Hobson and Bob Calvert John Hudson	11 77 8 GF
233	Interview: Brian Wood Dave Worth	8 77 9 G
234	Ireland, Hang gliding in Slingo and Fermanagh by Mark Leslie	12 77 21 R
235	Irish hang gliding sites, <i>Map of</i> by Mark Leslie	12 77 21 R
236	I took off on Thursday and landed on Friday Phil Robinson	1 77 16 F
237	Jim McDougal flies 13 miles Ian Trotter	8 77 20 F
238	Karabiner commonsense Noel Whittall	10 77 11 S

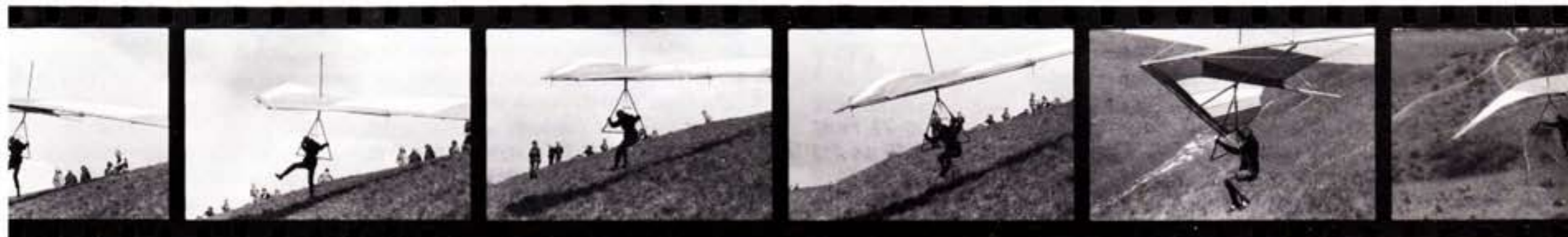
239	League entry competition, 29/31.10.77	Brian Milton	12 77 16 C
240	League, 1st competition '77 (Birdman)	Bob Wishart	4 77 17 C
241	League, 1977, <i>The British Hang Gliding</i>	Tony Fuell	12 77 10 C
242	League, <i>The</i> - Its history and ambitions	Brian Milton	12 77 12 C
243	Loopy, <i>Don't be</i>	Lester Cruse	9 77 12 AF
244	Magazines, <i>Foreign hang gliding</i>	Tony Fuell	2 77 4 R
245	Manufacturers, <i>Are we getting a fair deal from our</i>	Tony Fuell	1 77 3 SG
246	Mere, 1977	Dave Worth	10 77 12 C
247	Meteorology, <i>Handbook of aviation</i>	Tim Gilbert	11 77 21 R
248	Miles, 14, 16, 18	Bob Calvert	10 77 9 F
249	Minto magic, 1977	Tony Fuell	7 77 13 C
250	Mitchell wing, <i>The</i>	Don Mitchell	5 77 19 TF
251	Mountain hop, <i>An exploratory</i>	Barrie Annette	2 77 8 F
252	Mynd invitational, 16/17.4.77	Dave Worth	5 77 28 C
253	Nigel Milnes - 22 miles and 6000 ft	Bob Wishart	6 77 22 F
254	No wind take-offs	Graham Slater	12 77 9 S
255	Observers, <i>B.H.G.A.</i>		12 77 23 B
256	Order in the air, part 2	Freddy de Frias	1 77 33 FBS
257	Orientation in flight	Dunstan Hadley	5 77 24 S
258	Oxygen	Dunstan Hadley	2 77 27 S
259	Pandy to Hay Bluff	Ken Messenger	6 77 29 F
260	Pennine Club competition, <i>The</i>	John Hudson	12 77 17 C
261	Pen y fan	Jane Pulman, Paul Gigg and Kev Jordan	3 77 12 F
262	Performance testing	Kev Jordan	6 77 24 T
263	Powered hang gliding conference, 18.8.77	Chris Corston	10 77 19 M
264	Powered midas, <i>The short history of the</i>	Dave Simpson	8 77 14 FG
265	President's Trophy, <i>The B.H.G.A.</i>	Tony Fuell	3 77 30 B
266	Protective clothing	Dunstan Hadley	1 77 20 S
267	Radio communications	John Westcott	6 77 39 T
268	Rádio notes	John Westcott	1 77 21 TG
269	Round and round and round and	Steve Rogers	3 77 15 T
270	Sails	Paul Maratos	7 77 24 T
271	Skyway code, <i>The new</i> 'Mark'		4 77 32 G
272	Spot the lashup	Chris Coleman	4 77 10 S
273	Stirrup, <i>Finding your</i>	Geoff Shine	11 77 11 S
274	Structural integrity	Steve Hunt	9 77 10 T
275	Teams, <i>Future British hang gliding</i>	Graham Leason	1 77 31 C
276	Thermalling tips	Bob Calvert	9 77 21 FS
277	Transmit from mid air on 129.9 MHz, <i>Permission to</i>	John Westcott	7 77 9 T
278	Tredegar to Newport	Bob Wishart	6 77 28 F
279	Trip Mellinger flies 26 miles across the Pacific under power		12 77 15 F
280	Tuning, <i>Hang glider</i>	Graham Hobson	3 77 21 T
281	Turn deserves another, <i>One good</i>	Ian Trotter	9 77 23 S
282	Variometers, <i>Up, down and</i>	Ross Hay	3 77 26 T
283	We're on your side, really	Freddy de Frias	3 77 29 BFT
284	Where did you get that hat, where did you get that tile?	Dunstan Hadley	1 77 20 S
285	Wires, <i>Watch your</i> 'Daedalus'		2 77 20 S

1978

286	Abroad, <i>Planning a holiday</i>	Dave Roberts	3 78 10 G
287	Accident and others, <i>My</i>	Tony Fuell	11 78 11 AF
288	Accidents happen by Ann Welch	Tony Fuell	10 78 31 R
289	Accident investigation report: the first six months of 1978	Tony Fuell	7 78 27 A
290	Accidents, <i>Recent</i>	Tony Fuell and John Hunter	6 78 20 A
291	Accidents, <i>Recent</i> (mid-air 16.7.78)	Tony Fuell and John Hunter	9 78 14 A
292	Accidents - regional reporting system	Will Jones	3 78 20 AB
293	A.G.M. '78, <i>Report of</i>	Chris Corston	4 78 21 M
294	Air law	Paul Bridges	10 78 28 T
295	Airports, <i>The book of</i> by Ann Welch	Malcolm Honeychurch	10 78 32 R
296	American cup report	Brian Milton	11 78 15 C
297	American cup, team manager's diary	Derek Evans	11 78 20 FC
298	Atlas Express national final	Brian Milton	10 78 17 C
299	Beside the sea, <i>A day</i>	Tony Fuell	3 78 18 F
300	B.H.G.M.F., <i>Members of</i>		5 78 18 B
301	Big 'A' frames - short pilots	I.J. Christian	3 78 9 T
302	Big one, <i>So you say you want a</i>	Jim Debaucher	6 78 11 C
303	Birdmen, A guide to hang gliding by Ken Messenger and Ronnie Pearson	Nick Regan	8 78 20 R
304	Bleriot blow out '78	Trevor Birkbeck	11 78 26 CG
305	Brown flying suits, <i>In praise of</i>	Ian Trotter	1 78 6 AS
306	Bumper racks	John Hudson	5 78 17 G
307	Close encounters of the twenty fourth kind	Bob Calvert	7 78 18 F
308	Convergence	Ivor John	8 78 10 FT
309	Convergence	Dave Weeks	4 78 20 F
310	Cork '78, The fly-in at the Fly-Inn	Ray Hammond	4 78 16 C

311	Council matters: Council meeting 2.4.78	Chris Corston	5 78 6 BM
312	Council matters: Council meeting 7.5.78	Chris Corston	6 78 6 BM
313	Council matters: Council meeting 11.6.78	Chris Corston	7 78 6 BM
314	Council matters: Council meeting 16.7.78	Chris Corston	9 78 6 BM
315	Council matters: Council meeting 20.8.78	Chris Corston	10 78 6 BM
316	Council matters: Council meeting 1.10.78	Chris Corston	11 78 6 BM
317	Council matters: Council meeting 5.11.78	Chris Corston	12 78 8 BM
318	Crash landings (letter)	Dunstan Hadley	7 78 7 S
319	Dave Cook, Interview	Dave Worth	7 78 20 GF
320	Deflexor wire systems and safety	J.P. Beukers	3 78 10 T
321	Delusion, <i>The grand</i> (American cup)	Michael Jones	11 78 23 CG
322	Don'ts and don'ts, book of hang gliding by Bob Mackay and Bill Lehan	Tony Fuell	6 78 21 R
323	Dover and Folkestone Hang Gliding Club, <i>The</i>	Ivor John	9 78 21 G
324	Eger Kupa, <i>The</i>	Dave Worth	9 78 19 CFG
325	Fitness to fly	Dunstan Hadley	11 78 9 S
326	Flight without formulae by A.C. Kermod	Rod Bird	4 78 22 R
327	From one freedom to another	Ashley Doubtfire	11 78 13 FG
328	Getting the needle	Mick Pollard	4 78 9 T
329	Glenshee freak out '78	Ian Trotter	6 78 16 C
330	Guide angle and wind speed	Ian Thomas	4 78 9 ST
331	Glider colours and safety	John Lythgoe	8 78 16 S
332	Gliding among the Virgins	Bill Bullimore	4 78 17 FG
333	Hang gliding - catch the wind by Glenn Woodward	Trevor Birkbeck	3 78 21 R
334	Hang gliding 1928 style	Julian Wright	10 78 21 G
335	Harnesses	Dennis Pagen	5 78 15 TS
336	Himalayan skies, <i>Under</i>	Neil Kinnear	10 78 12 FG
337	Holland, <i>Hang gliding in</i>	Paul Beukers	4 78 17 FG
338	Home builders beware (letter)	Robin R. Smith	7 78 8 TS
339	Home building	Dave Cook	5 78 24 T
340	Instruments	John Hudson	5 78 13 T
341	Inter-thermal prospects	Bob Calvert	3 78 9 F
342	Interview: Miles Handley	Dave Worth	2 78 12 G
343	Ireland, <i>Hang gliding in</i> (Achill, Mayo and Galway) by Mark Leslie	Roger S. Millbourn	2 78 21 R
344	Keep it up clean safe!	Bob Harrison	12 78 17 S
345	Kite reports		5 78 8 GT
346	Kites by Ron Moulton	Nick Regan and Mandy West	10 78 31 R
347	K.O. KO'd '77	Bob Mackay	1 78 17 C
348	Kössen, 1978	Roy Hill	10 78 22 C
349	L/D contest, <i>George Worthington's</i> (Comments by Don Betts)	George Worthington	4 78 12 C
350	League entry '78	Dave Squires	11 78 28 C
351	League news	Dave Worth	4 78 19 C
352	League at 1.6.78		7 78 16 C
353	Leagues, <i>Area</i>	Brian Milton	2 78 19 C
354	Magnificent men and their	Those Paul Renouf	1 78 18 G
355	Medical officers	Dunstan Hadley	4 78 23 S
356	Mere '78	Garth Thomas	8 78 21 C
357	Mere '78 (Reprinted from Avon H.G.C. newsletter)		11 78 26 C
358	Meteorology for glider pilots, 3rd international edition by C.E. Wallington	Tony Fuell	3 78 21 R
359	Mount Lachenes, what we did on our holidays	Tony Fuell	9 78 17 FG
360	Nationwide crash, <i>The</i>	Brian Milton and Len Gabriels	11 78 12 A
361	Night flying	Dunstan Hadley	7 78 25 S
362	Nosewires, <i>Competance on the</i>	Sandra Jones and Edmond Hui	7 78 9 S
363	Observers '77		6 78 24 B
364	Parachute landings	Stephen O'Brien	6 78 10 S
365	Parachutes	Tony Fuell	3 78 14 SF
366	Parachutes, <i>Drogue</i>	David Squires	1 78 9 T
367	Perranporth rally '78 (UK hang gliding rally)	Paul Renouf	6 78 15 C
368	Photography, <i>Hang glider</i>	Alan James	12 78 13 GT
369	Pilot rating system, <i>B.H.G.A.</i>		6 78 (Enclosure) B
370	Powered hang gliding, <i>Initial working document on the regulations for</i>	Brian Milton	6 78 19 B
371	Powered hang gliding, <i>The case for</i>	Mark Woodhams	9 78 12 FG
372	Power meet in Powys	Jonny Seccombe	11 78 10 FG
373	Powernatic	Jonny Seccombe	10 78 9 G
374	Power Page, <i>The</i>		12 78 12 B
375	Prone, <i>Converting to</i>	Bob Mackay	2 78 9 SF
376	Propeller making for the amateur by Eric Clutton	Dave Cook	5 78 24 R
377	Royal Aero Club, <i>At the</i>	Jeannie Knight	12 78 20 G
378	Safety and first-aid for the beginner to intermediate pilot, <i>Guidelines on</i> by David and Elizabeth Squires	Dave Worth	2 78 21 R
379	Safety and hang gliding - a re-appraisal	Mick Pollard	12 78 17 SG
380	Sail repairs, <i>Hand stitched</i>	Ray Acott	6 78 9 T
381	Scandinavia, <i>A trip to</i>	Jim Clithero	4 78 18 FG
382	Schools '78, <i>List of</i>		6 78 12 B
383	Sea, <i>Going down in the</i>	John Lythgoe	7 78 22 S

384	Seagulls can do it, <i>If the</i> David Bell	7 78 17 F	400	Water landings Noel Whittal and Brian Arkle	6 78 9 S
385	Sites Guide, <i>B.H.G.A.</i> Barrie Annette	9 78 6 B	401	Wave, <i>New</i> John Hudson and Bob Calvert	6 78 17 F
386	Skyhook power Len Gabriels	1 78 12 TF	402	Waves, <i>Lee</i> , Part 1 Ivor John	10 78 15 TF
387	Stalling - and apples Ann Welch	11 78 8 S	403	Weather flying by Robert N. Buck Ian Trotter	2 78 21 R
388	Stalls Graham Hobson	2 78 16 FS	404	What do you do when you can't get down Roy Hill	7 78 9 FS
389	Take-offs, <i>E.e.e.sy</i> Ian Trotter	9 78 9 S	405	Worthington Column, <i>The George</i> (American Cup)	
390	Thermaling the Bob Bailey way Bob Bailey	3 78 9 F		George Worthington	11 78 22 CG
391	Think up Martin Trickett	8 78 9 F	406	Worthington Column, <i>The George</i> (The American Eaglet)	
392	Three quarters of a mile high over Innsbruck Mike Stainer	3 78 13 F		George Worthington	9 78 13 G
393	Three quarters of a mile over Brighton Johnny Carr	7 78 19 F	407	Worthington Column, <i>The George</i> (Girls' Records)	
394	Training conference, <i>Scottish</i> Ian Trotter	2 78 22 M		George Worthington	12 78 14 FG
395	Turning, turbulence and flexible wings Everard Cunion	8 78 17 T	408	Worthington Column, <i>The George</i> (The Real World)	
396	Ups and downs Kev Jordan	1 78 21 FT		George Worthington	7 78 12 G
397	Visit of James M. Meade to Malvern (Mitchell Wing)		409	Worthington Column, <i>The George</i> (Rigid Wings v Rogallos)	
	Theo Willford	11 78 23 G		George Worthington	8 78 11 FT
398	Volmer Jensen - "genius" Dave Cook	12 78 9 G	410	Yarana or friendship Ken Barker	7 78 13 FG
399	Warm, <i>The importance of keeping</i> Dunstan Hadley	2 78 18 S			



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Wasp Falcon IV. All original parts in excellent condition. Flown 20 hours and soared in 12mph wind. Very good clean multi-coloured sail. £300 ono. Phone John Jenkins, Preston (Dorset) 0305 833160.

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Wasp Falcon IVB. Beautiful condition, nice sail, never pranged, well cared for, must go to conscientious pilot. Will suit capable beginner or intermediate. THE classic floater, for £340. Tel: Howard Rockliffe, Maidenhead 34588.

21ft. Cloudbase De Luxe. Purple and gold sail. Complete with bag and seated harness. Good condition. Ideal beginner/intermediate kite. £220 ono. Tel: Leeds 704270.

Cloudbase, orange, white and yellow, excellent condition, superb flyer. Seated or prone £225 ono including seat and bag. Phone evenings 02273 62874.

Sunspot, excellent condition. New '78 and lightly flown. £350 ono for quick sale. Please ring Steve, Bishopston 3763 (on the road to Rhossili).

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SST 100B. This superb kite is suitable for E.P.C./Pilot One holder. Rigs seated or prone. £325 ono, delivery may be arranged. Ring Lesley, Linley (058 861) 322.

Falcon 3, only £250. Ring Jim, 01 542-6978.

Super Scorpion B. Attractive multi-coloured sail. There will never be an easier machine to fly. Get ready for this summer. £415 ono. Ring Andy Smith, 01 303-8255.

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McBroom Cobra 188. Well cared for. Suit beginner to intermediate up to 11st. Seated or prone. £180 ono with seated harness. Tel: 01 353-4242. Ext. 660 (work) or 01 852-7312 (home). Ask for Roy.

Phoenix Mariah 170 for sale — suit pilot rated. Best offer secures. Phone Nigel Milnes, Bristol 32972.

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