Dec 1958 SAG

SOME THOUGHTS ON BUNGEYMANSHIP

by David Carrow

THE hilltop bungey-launch is different from all other methods of getting a glider into the air, because it must never fail. On most launching sites a trickle down the hillside will spell disaster. This is the fundamental contrast with auto-launch fumbles, winch failures and even aero-tow panics (as far as the glider is concerned!) and therefore a fundamentally different and rather cautious attitude of mind is necessary when bungeying. It must not fail.

I have learnt this lesson for myself the hard way in the Cambridge Club, where we have a tradition of holiday expeditions to little-known or completely untried hill sites. Of the eleven expedition launches I have attempted to date, two have failed to get me airborne at all, a third which did get me flying gave quite the closest shave one could wish for, two more have been uncomfortable and only six satisfactory. This is too high a dice rate, and the fact that most of these launches have been in various parts of North Wales is a coincidence that reflects not at all on the safety merits of that excellent hill-soaring country. The difficulties arise chiefly from the fact that the standard bungey was designed to cope with pre-war gliders and has not been improved since.

THE BUNGEY ITSELF

First of all, what is a bungey? A multitude of tiny rubber threads, thirty yards long, bound round and constrained externally in a braided tubular cotton cover of about ¾-in. diameter. This constraint prevents the bungey from relaxing fully and gives the rubber threads a calculated degree of pre-tension, some three or so times their natural length. The bungey is normally made up in a "V" rope of two 30-yard strands. Fig. 1 shows the tension/extension curves given by Luke Turner, the makers, for a single strand of new bungey overstretched to 110% extension, and also for our own "used" bungey, three years old, stretched to the recommended maximum extension of 100%. From this graph one observes the comparatively high "breakout" force necessary before any appreciable extension can be obtained; one can also calculate the stored energy at 100% extension which comes out for the "used" bungey

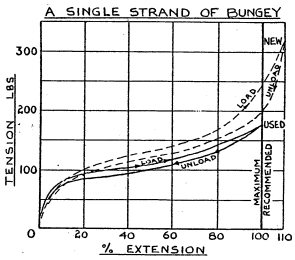

FIG: 1

to 18,000 ft. lb. for a two-strand rope. (Incidentally the area between the loading and unloading curves represents the energy absorption or "shock absorbing" properties of this type of cord.)

A bungey needs loving care and affection; it grows old and loses its elasticity. Oil, that commodity inseparable from gliding, rots rubber very quickly indeed; sunlight is bad and so, obviously, is overstretching. Since it must never fail, a bungey must be maintained to aircraft, not M.T., standards of serviceability and resolutely rejected when u/s with the same firmness that one discards a tattered elevator cable.

THE ENERGY REQUIRED TO LAUNCH A GLIDER

Now for some figures. Let us wheel a Tutor out on to a flat runway in the calm of the evening and try to get it airborne to a controllable flying speed just above the stall, say, 450 lb. accelerated to 25 kts. Neglecting ground friction and air drag, the energy requirement works out at 12,500 ft. lb. and we have available 18,000 ft. lb., so a nice low hop results, particularly if we insert extra energy by keeping the bungey crew running while the glider is accelerating, giving a run-on or auto-tow effect which can add very appreciably to the energy input (but see later).

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Let's try an Eagle in the same conditions; the requirement is to accelerate say 1,200 lbs. to 38 kts. The energy requirement is then 77,200 ft. lb., and as we still only have our 18,000 ft. lb., the result is pathetic. We can in fact store in our bungey a maximum figure of less than one quarter of the energy necessary to get an Eagle flying. Even with an Olympia (670 lbs. and 32 kts. = 30,500 ft. lb.) we can only store rather under two-thirds of the energy needed. These are all flat-site zero-wind figures.

FIG: 2

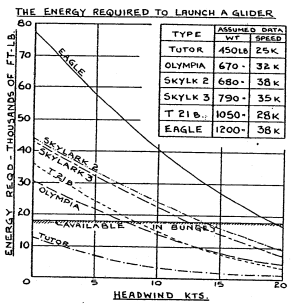


Fig. 2 shows the energy requirements of various modern gliders (again flat-site and neglecting ground friction and air drag) in zero wind and in increasing headwinds. Wind helps by reducing directly the speed requirement; if there is a 10 kt. wind we need accelerate our Eagle to only 28 kts., and so on.

In practice a safety margin is necessary to overcome ground friction, particularly if the ground is rough or covered in heather, or if one has a skidded aircraft. Air drag can, however, be safely neglected.

A down-hill slope can help very considerably. Neglecting friction again, *any* slope with a vertical drop of 70 ft. will accelerate *any* glider to 40 kts. (see Fig. 3) An ideal bungey site could therefore consist of a concrete ramp with a drop of, say, 100 ft. and with no bungey needed at all, and there are in fact sites where this could be a sensible suggestion! To take a more typical case, on a 1 in 10 slope, with no run-on of the crew during the launch, a Skylark III can obtain some 7,000 ft. lbs. energy from the slope while the bungey is contracting, i.e., almost half that in the bungey itself.

The run-on of the bungey crew after the glider starts moving, up to the moment the bungey drops off, produces an auto-tow effect which can add most substantially to the energy input. As a very rough approximation, which errs on the side of safety, a run-on at, say, 5 kts. is equivalent to a corresponding 5 kts. increase in wind strength. But (*pace* Bill Crease) we must not rely on this run-on; people trip over rabbit holes, and jeeps (the auto-bungey case) can drop dead too. The run-on adds to our safety margin; we must not rely on it.

I proceed now to the solemn enunciation of the First Principle of Bungeymanship:

"*There shall be sufficient energy inherent in the system at the instant the glider starts to move that it cannot fail to get airborne.*"

To put the thing another way, in a formula for the mathematically minded:

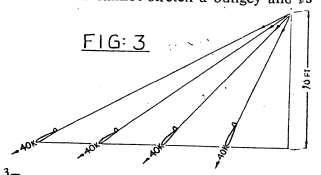
"*The energy stored in the bungey fully stretched plus the energy inherent in the downhill slope less a margin for ground friction shall exceed the energy requirement of the glider in the wind strength available.*"

BASIC HAND-BUNGEYMANSHIP

The terms of reference I have set myself in these thoughts do not include the choice of a suitable hill site or launching run except to say that measurements must be made to ensure that there be sufficient distance for the crew to run down the slope for the bungey to reach 100% extension. This is not as obvious as it sounds, and an accident has happened owing to the crew reaching the edge of a cliff with the bungey only partly extended—a worse accident would probably have occurred had the pilot chosen that instant to release his end and bungey his crew into space. . . .

Owing to the comparatively high "breakout" force required (see Fig. 1 again), one man a side cannot stretch a bungey and is

FIG: 3



useless. Two men can put but little energy into the system—remember it is *stored* energy that counts; three is the minimum and more than four a side can overstretch and break the rope. Hence the edict that a hand-bungey crew shall consist of not less than three nor more than four a side. There must be one experienced man per side; the rest may be ignorant bystanders, but they should be carefully briefed.

I have found the airbrakes ideal to signal from the cockpit to all concerned. One shuts them when one is ready, and this has the further advantage of ensuring that one cannot be launched with them open. The wing-tip man then takes over and shouts "WALK" (to take up the slack), "RUN" (all out) and "LET GO" (for the holder-backer, not the bungey crew!) This last should be given when the bungey reaches 100% extension, either estimated by eye, or rather better by using a short "tell-tale" stretch indicator in the rope. Actually, if the correct number a side is used, they will begin to grind to a halt at about 100% extension owing to the steepening of the tension/extension curve (Fig. 1 again), and/or the holder-backer will run out of strength, but a hand-bungey is always a bit approximate.

As far as possible, the launch should be always under the control of the pilot, so that if he starts moving before the bungey is fully stretched, or if his acceleration is then insufficiently rapid, or a wing drops, or some other untoward event occurs, he can break the launch off by releasing the bungey and slide to a halt, possibly by ground-looping with slight damage to avoid a more serious accident. The launch should therefore be made on the Ottfur hook and not on the open bungey hook (the B.G.A. operational regulations have, I understand, been modified to permit this). A short length of 1,000 lb. breaking-strain nylon aero-tow rope may be used to provide the statutory weak link. This weak link must be kept in tiptop condition and replaced regularly to prevent any possibility of a mid-launch break. The usual Ottfur checks should be made before each launch, and during the launch the pilot should release as the bungey comes slack and not wait for the bungey to back-release, as there is a risk of it trailing back and catching on the wheel box or wheel trolley hooks. During the launch the tail should be kept down and the glider hauled into the air as early as possible.

The wing-tip man should not attempt to run forward with the tip: the acceleration is too smart and he may swing the wing round. He should remain stationary and let go.

The success of the launch depends on storing energy in the bungey, and this means that the bungey must be fully stretched. To achieve this, a holder-backer on the ground behind the tail is essential. A reverse-facing hook under the tail, as on some Olympias, is ideal to enable this member of the organization to really do his job properly, with feet dug in and a short piece of rope. One of my ghastly incidents arose through my putting an ignorant bystander on the tail. This holding back is vital and I have no hesitation therefore in stating this Second Principle of Bungeymanship:

"*There shall be a holder backer regardless of how strong the wind is.*"

AUTO-BUNGEYMANSHIP

The principle of using a jeep instead of a bungey crew, with both strands of bungey running parallel back to the glider, and with the glider launching over the top of the vehicle, is now quite widely known and is perfectly safe provided all the factors involved are appreciated. Chief of these is the very real danger of producing a dreaded "bungeybang" with the jeep overstretching and finally breaking the bungey. To prevent this we use a guardrope, twice the length of the bungey, so that at 100% extension the rope becomes tight and the glider is forcibly pulled, regardless, out of the holding-back organization's hands. The guardrope is lightly bound with insulating tape at intervals to the bungey, the intervals being closer near the glider to minimize the risk of the guardrope looping back before the bungey is released and catching on the wheelbox, etc. Fig. 4 shows a plan view of a typical auto-bungey set-up before moving off. One of the chief merits is that only four persons are needed in the system.

Even with the guardrope, the jeep must not be driven too fast through the 100% extension point or there is a very real risk of something overstretching and breaking. This could even be delayed (in an extreme case of the jeep accelerating faster than the glider) until some time after the glider has begun to move, with a possibly disastrous "trickle" resulting. (This has happened).

A steady 5 m.p.h. throughout is ideal, and the jeep should be driven first down the

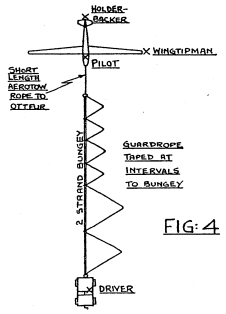


FIG: 4

slope on a dummy run to ensure the ground is satisfactory with no boulders, ditches, etc. Preferably the jeep should not run out of petrol or otherwise break down with the bungey half-cocked (this has happened). A guardrope with little stretch should be used —a thin nylon aero-tow guardrope stretches too much and one reaches the stage of "Who will guard the guardrope?"

The jeep driver must be protected against a bungeybang and there ought to be a quick-release at the jeep in case the Ottfur fails. Towards the end of its run the jeep should make a gentle planned curve to left or right depending on the terrain, so that in the event of a marginal launch the glider fuselage will pass to one side, and provided the jeep driver ducks (this has happened) all will be well. A direct signal by the pilot closing the air brakes tells the jeep when to go and the pilot *must* release the Ottfur should the glider begin to move before the guardrope comes tight. In fact, because the forces and factors involved are under closer control, a jeep bungey is probably to be preferred to a hand bungey under similar conditions.

CONCLUSION

I would like to acknowledge considerable help (not to say argument) from Bill Crease, David Clayton, Laurie Vandome, Ken Machin, Messrs. Luke Turner and several others. Many, if not all, of the ideas are theirs.

Finally, I cannot help recommending bungeying as a WAY OF LIFE; quite soon it becomes an END in itself and not just a MEANS. I am reminded of the ultimate stage of fishing which my respected father has now reached, where he does not actually take a rod on the water, but just observes the fish and plots out in full detail how to stalk and catch it. On several of our happiest bungey-launch reconnaissances, we have not actually had a glider with us. . . .

BOOK REVIEW

Natural Aerodynamics by R. S. SCORER. Published by Pergamon Press, London, 1958. Price 60s.

HERE is an altogether delightful, stimulating and sometimes deliberately irrelevant account of our atmosphere and its behaviour. Among the digressions, of which the Author warns us in his preface, we can read of dynamic soaring, atmospheric pollution, jet streams, clear air turbulence and the bangs of man-made explosions, meteorites and volcanic eruptions.

Chapters 7 and 9, however, with their careful explanation and theoretical forms of upcurrents—thermal and wave—were surely written for the sailplane pilot. It is a fascinating story concerning which we must each satisfy ourselves that what the author has shown is in accordance with our own experience. Here is a stimulus to better observation and greater awareness of our surroundings as we fly.

Perhaps by this book, to which he does scant justice in his recent letter to SAILPLANE & GLIDING, Dick Scorer will provoke the gliding fraternity into providing some of the information which he says he lacks. It is the very least that we could do in return for this most valuable contribution to the art.

D. H. G. INCE

Priest's Crag

Being an account of the travels of four gentlemen and a Skylark from the University of Cambridge amongst the Cumbrian Mountains.

Distilled by ANTHONY EDWARDS *from conflicting accounts of the events, and censored by* JOHN GRIFFITHS *and* PETER BULMAN.

SOME time ago it was suggested that Messrs. Griffiths, Bulman and Edwards should take the C.U.G.C. Olympia to Wales this spring. And so it happened that in the middle of March we three set out for the Pennines with the Skylark II in tow. For in March there is a good chance that north-easterlies will blow, setting up lee waves from the Crossfell range. The collection of the various pieces of equipment for the expedition kept Peter busy (I nearly said quiet) for a whole term. The Skylark, it is true, was at Marshall's; the oxygen came from Coton by way of Norwich and the Cambridge Fire Station, the wireless from Girton, and the barograph from London. The axleless trailer at Baldock was united with a trailerless axle from Walsall a matter of hours before our departure.

I think it was a Wednesday when we left Cambridge for the North. We intended to fly at S*tt*n B*nk for a day before proceeding to Crossfell, so we drove up the A.1. With the dark came the snow, and although it had stopped falling by the time we reached York, every mile it lay thicker on the ground. But we were happy—we had four-wheel drive and six fully-inflated tyres . . . well, five and a half . . .

"Peter—take a look at the trailer tyres".

"Oh—that leaves us with five".

So we backed the trailer into a snowdrift, on which we jacked it up, and removed the offending wheel. The Jeep, relieved of its burden, took us up onto the moors past stranded saloon cars. We were confident in her ability to swim, if necessary. By this time John was driving, and I was in the back, sandwiched between suitcases and the trailer wheel, my only experience of the outside world being through the conversation of the two who could have seen out had the windscreen wiper been working.

"I think the road must be more to the right".

"Oh—are you sure there is a road here?"

"Yes, it's on the map."

"——"

"Try reversing".

"Pity the tyres are so bald".

"I think we'll have to get out".

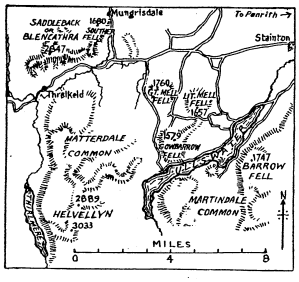
Peter and John stepped from the Jeep up onto the snow, and disappeared ahead in search of the Y*rksh*r* Gliding Club. When they returned, having found the uninterrupted examination of virgin snow by torchlight rather tedious, we started to dig the snow from under the Jeep with our hands, our feet, and the starting handle. The Jeep seemed to be balancing on a mountain of compressed snow by its sump and back axle, with the result that the two hours spent removing the snow from under the wheels were remarkably fruitless. So we set out in search of the clubhouse again,

Time to "D.I." the vehicles, but at 6 a.m. Anthony Edwards has hardly woken up to what he is doing.

this time in the opposite direction, hoping to find a shovel. On retracing the Jeep's tracks, we soon came to the turning that we should have taken, and eventually found the clubhouse. We returned to the Jeep with one-and-a-half shovels and more enthusiasm, and an hour later we were back on the right road, progressing like a destroyer in a heavy swell: not much roll, but plenty of pitch. If there had been an onlooker, and if it had not been night, he would have seen no Jeep, but merely a spray of snow lurching through (rather than across) the featureless countryside.

At 4 o'clock in the morning we arrived at the clubhouse, broke in, and unpacked our sleeping bags. The walls seemed to serve no purpose other than separating the snow inside the clubhouse from the snow outside. For some reason (I think it was Peter) we did not settle down to sleep until 6 o'clock. Three hours later, with the snowscape floodlit by a brilliant sun, it occurred to us that we ought to rescue our trailer before its snowdrift melted. So we bought a new tyre—necessary, alas—and towed the trailer a little nearer to the club, parking it in another roadside snowdrift, to the probable confusion of those stranded motorists who had been using it as a landmark.

The wind was unsuitable for soaring the ridge, so towards evening we set off to Carlisle to collect our ground crew, Stuart Waller. After leaving the trailer where we had booked for the night, near Penrith, we drove into Carlisle with the windscreen open because of a fog which had descended. This improved the visibility, because the fog



was then inside the Jeep as well as outside.

The poor reader of this article must by now be in the same frame of mind as we were on the following morning—thinking it was time there was some flying. In a cloudless sky we drove up the main road over Hartside, and half way up got out to sample the wind.

"It's a bit light, isn't it?"

"You've got no courage . . . but perhaps it is".

"That's funny—it's coming down the hill".

"So it is".

"Perhaps we should have got a forecast".

"Yes".

We drove down the hill again, and across to the Lake District.

At Christmas Peter and John had been on a preliminary expedition to look for auto-bunjy sites, and this is a good place to describe their intended method of catching the Crossfell wave without an aero-tow.

North of Ullswater there are four hills soarable in an easterly wind, arranged in a line north-west to south-east. On the most easterly hill, Little Mell Fell, Peter and John found a launching site, and the other hills—Great Mell Fell, Souther Fell, and Blencathra or "Saddleback" can be reached in turn from there. The theory is that on one of these hills the hill lift will be in phase with the wave lift.

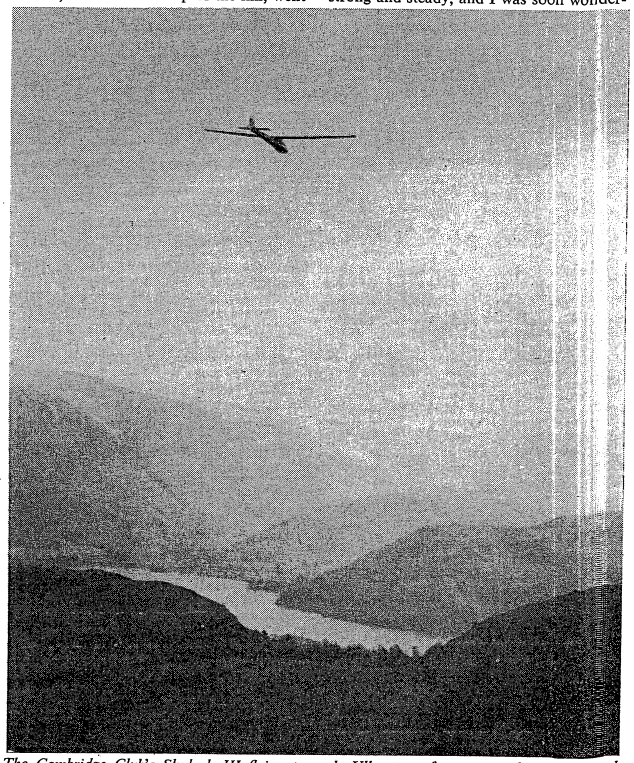
Throughout the expedition the wind blew from the south-east quarter, and we only used one launching site. This was not the one originally chosen by Peter and John, but a much better one only a few hundred yards away on the top of Priest's Crag (Grid Reference 25/425233). We always rigged the Skylark beside the road at The Hause, the top of the pass between Priest's Crag and Little Mell Fell, and then towed it up the hill for launching. A little way to the south-west of the launching site is a flat landing strip eighty yards long, but more of that anon.

That afternoon John pioneered the route back to Saddleback in a fifteen-knot south-easterly wind. He writes:

"Although a polar curve and a map had convinced me that the route was feasible, I felt a little anxious on leaving Little Mell Fell, as Saddleback, seven miles away, was invisible in the haze, and Great Mell Fell looked like one of those conical hills depicted in books on soaring with all the

streamlines going round the sides. I arrived on Great Mell Fell surprisingly low and eventually located lift in a tree-covered gully. I hurtled in and out of this gully for a few minutes, and, after being outclimbed by a hawk, arrived at the top of the hill, went round the trees, and headed towards Souther Fell.

"On this occasion I lost little height and arrived about half-way up the Fell, five hundred feet below the top. The lift was strong and steady, and I was soon wonder-



The Cambridge Club's Skylark III flying towards Ullswater after an auto-bungey launch from Priest's Crag.

ing how to cross the remaining two miles to Saddleback, consisting of hill and snow. A frontal assault from the east ended in a quick turn out of a trap and a hasty retreat past a shepherd waving down at me with his stick. His sheep were not as worried as I was.

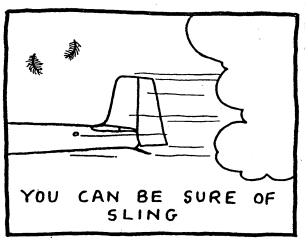
"I then tried a flanking movement down the valley to the south, where Saddleback pushes out a succession of ridges like splayed-out fingers, each of which was partly soarable and partly not, due to the down-draught from the one in front. As I crossed each ridge the Skylark was hurled up in the air, shaken up, stalled, and hurled down again.

"I was soon level with the top of the magnificent bowl of Saddleback, which is an 800 ft. rock face rising to 2,800 ft., completely open to the east wind for twenty miles. I crossed over to it, expecting to be thrown up violently, and slowly sank below the top. The wind clearly had more south in it at that height.

"After an argument over the radio, and much manipulation of slide rules, I returned up-wind to Little Mell Fell and landed back on top, feeling very pleased."

Early next day Peter was launched in a light wind, and fled like a startled rabbit to a bottom landing field, taking 100 seconds to lose 650 ft. We went back to breakfast after collecting him. This meal usually occurred before noon, at the King's Arms in Stainton, where we were staying. Here our eccentricities were accepted, and even encouraged, by the landlord and his wife, and we can thoroughly recommend this inn to a future expedition. The bills were trivial compared with the quantity of food we ate, and even Peter's blowing of the coaching horn at 6 o'clock on a Sunday morning did not have us expelled.

That afternoon the wind went round to the south, and a low inversion set in. After much deliberation it was decided to launch me from Priest's Crag, although the ridge was not soarable, to explore a south-facing bowl a third of a mile away. A good launch found me there, and I spent one and a half hours flying locally. I tried both Little Mell Fell and Gowbarrow Fell, but in neither case could I hold hill-top height, and I had to beat a hasty retreat. However, a pleasant, if trivial, flight was spoiled by overshooting a few yards on the top landing strip, resulting in a curious method of damaging a sailplane, wherein a hillock is introduced



into the fuselage after the aircraft had stopped rolling.

And so the following morning—Sunday—Peter and John took the damage to Kirbymoorside, returning on the Wednesday. Meanwhile, Stuart and I spent the time pedalling around the Eden valley on very old female bicycles looking for autobunjy sites. The only one of note we found is at Grid Reference 35/483232, for use in a west to north-west wind, when Barton Fell should be soarable. This long ridge rises almost straight out of Ullswater, and is very steep for a height of 1,000 ft.

On Thursday, thanks to Slingsby Sailplanes, John was launched in a light wind from Priest's Crag, after we had fired a smoke puff from the bottom of the hill to test the lift, to the consternation of the local sheep farmers. After an hour at hilltop height, the rest of us encouraged him, by radio, to come even lower so that we could take some photographs. This he did, but just then the wind dropped, and he continued on to the bottom to sample another field. After a late breakfast, Peter flew in better conditions, and made the trip to Souther Fell, being unable to drop back on to Saddleback because of cloud. He landed at dusk in a field at the foot of the Fell, having been airborne for three hours.

And so, on Friday, my turn came round again. The conditions seemed ideal for the pilgrimage to Saddleback, but it took some time to get away from hill-top level on Priest's Crag. I arrived on Souther Fell only 500 ft. above the field in which Peter had landed, but so beautiful is this fell that the light wind soon had me 500 ft. above the top. But this was not enough for the step back onto Saddleback: several times I tried creeping round the corner, only to

be met by a rock face and the red ball simultaneously. However, the ridge was soarable for several miles towards Carlisle, and after sampling it I landed at Mungrisdale, at the foot of one of the valleys that pierce the ridge.

On the next day John completed a fifty-kilometre triangle entirely without thermal assistance. This, perhaps the best flight of the camp, deserves to be fully related, but John's promised account had not arrived. I hope he will produce it later, to be printed separately. Unfortunately the material consequence of the flight was the appearance of the Skylark, inverted, in the backyard of the King's Arms that evening. We obtained some oakfaced ply from the local carpenter, and some plastic-to-wood Aerolite. This being colourless, we thought of adding barograph ink to it, but it is hard to fool Ted Warner.

But all was ready in time for Peter's early morning trip to the bottom on Sunday. The wind was strong and smelt of waves. Peter reported extreme turbulence, and it was clear that our little hill was sitting in the down of a wave. I persuaded the others to launch me before returning to breakfast, and I employed the tactics of a previous flight—diving straight for the bowl. By the time I had got the wireless working I was at 3,000 ft. over Ullswater. I turned, to beat back along what was evidently a wave off Barton Fell, but the ground came rushing up to meet me, and in no time I was hill-scraping. For an hour I sampled the valley again and again, without success, and eventually landed exhausted. I had been flying the whole time in extremely rough air, using both hands on the stick, and flying at 50 m.p.h. (at which I.A.S. I was frequently stalled). I finally decided to land when, on making a turn at 55 m.p.h. near the hill, the Skylark behaved like a frightened Tutor as far as aileron was concerned. I shudder to think how a Tutor would have behaved!

I had been working in the belief that the most likely place for a wave was downwind of Barton Fell, and so I did not attempt to fly to Saddleback. But John did, and eventually reached 6,200 ft.

The last flight, on Monday, was a fitting end to the expedition. Peter climbed to 9,700 ft. in a standing wave, thereby completing his Silver C. He has provided a very comprehensive account of his flight, but I am afraid it is too long to include here. He was aloft for about four hours, and found the characteristic turbulence at the bottom and top of the wave, as well as the normal smooth lift in the middle. Twice he reached his top height, from where he reported cloud base to be about 15,000 ft. The wind was south-east, about 30 knots, and the whole flight was confined to a few miles around Ullswater. From the ground, conditions appeared to be better to the west, but although Peter flew around a little in search of other areas of lift, flying upwind at 110 m.p.h., he could find none.

And so the camp ended. After packing—both clothes and Skylark—we set out on the night trip to the Mynd. Even that had its exciting moments, but, undefeated, we arrived in the early hours of the following day, announcing our arrival, as any sheep in Shropshire will tell you, with the aid of some smoke puffs. We had had to take the Skylark to the Mynd in response to demand from the Cambridge campers . . . the next week the Mynd did not come out of cloud.

The three pilots would like to thank Stuart for his cheerful assistance, Mr. Slingsby for his rapid repair, and Dr. Machin for the loan of wireless and smoke-puff equipment. All were invaluable.