COME GLIDING WITH ME

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CHAPTER ONE

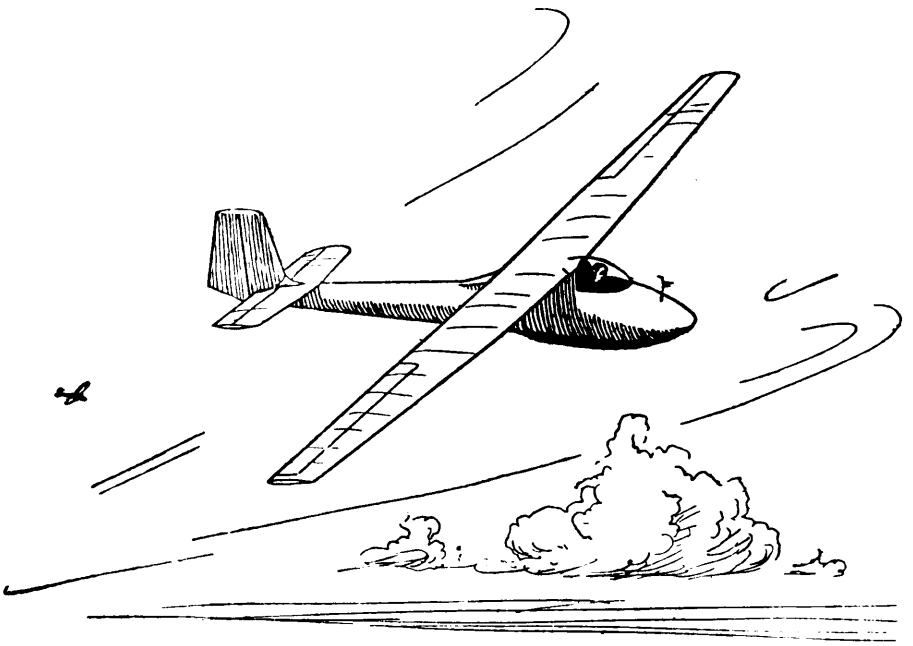
INTRODUCTION

WHAT is gliding? Why, when there are excellent motors of all varieties available, do you try to fly across country without one? What can gliding be used for? These are a few of the questions that are asked every time a glider lands in a strange field. Sometimes it is difficult to give a satisfactory answer, because many people today think that unless there is a sound material reason for doing things they might as well be left undone. To say "I like flying this way" may not help you much, although it is the main reason why people take up gliding, either instead of aeroplane flying, or as well as it. A number of airline pilots are enthusiastic glider pilots, because it is their chance to fly for fun with a freedom and lack of noise, not possible in any other form of heavier-than-air flight.

You can learn to fly gliders at any age, provided your feet can reach the rudder pedals, although you cannot actually go solo until you are sixteen. But there is no reason why you should not learn to drive the cars or tractors for retrieving the cable on the field, or even the winches, which launch the gliders a thousand feet into the air, before you have reached this age, if you are sensible and really keen.

You can take part in all the flying activities yourself, handling and helping to look after the gliders, signalling, repairing the cars and winches and launching cable, and you will get an enormous amount of fun, and make some very good friends.

You see, gliding is a sport, without licences, medicals or restrictions, just like sailing, canoeing or skiing. Of course, gliders have to be properly looked after so that they do not go wrong in the air, but this is done by the experienced club members who have approval from the National Association, which in turn is run by the most experienced gliding people in the country, usually as amateurs. The flying instructors are mostly volunteers, too, members who have first of all become very good



The Skylark single-seater.

pilots, and then learnt to be instructors, usually being trained in their own club by the Chief Instructor. Later, you could become an instructor as well.

But the real reason for flying gliders is to explore the air, and to fly as far as you can, or as high as you can by your own efforts alone. To set off for a day's flying, not knowing whether you will have to land within five

minutes or whether you will end the day hundreds of miles away, perhaps having set up a new record, has a charm and excitement all its own. There is so much that is not known about air currents and clouds, and where to find lift, that you are still a pioneer on almost every soaring flight. There is, after all, not much opportunity in the world today for new achievements unless you are part of a large organisation, or huge sums of money are involved. But only three people for instance, have flown a glider from England to France and no one has ever flown a glider from France to England. You could be the first! The equipment exists, and the money required is not beyond your reach as an individual.

Get out a map of the British Isles. No one has yet explored the air over Dartmoor, although it is known that a strange kind of lift, called a standing wave, exists in certain wind directions over this remote and legendary region.

No one has yet soared over the top of Snowdon. I was once launched off to attempt this, but all that happened was that I failed to stay up, landing safely in a field at the bottom of the lower slopes, and the fire brigade arrived because some unobservant person had telephoned them to say that an aeroplane had crashed in flames!

No party of glider pilots has yet spent a holiday really exploring the Lake District, although it is certain that hours of fascinating flying could be had there, launching from the mountains themselves and soaring high over the lakes.

In Scotland the Grampian range provides opportunities for exploration of the air which exist nowhere else in Europe north of the Alps. And no one has ever flown a glider from Scotland to Ireland. There is still the crossing from North to South Island in New Zealand to be achieved and no one has tried to soar for a thousand miles along the Pacific side of the Andes range.

But it is easy to ramble on like this, when it would be far better to take you to a gliding club and tell you about the things you will have to do and learn before you can fly a mile high over strange countryside alone with the birds. I shall take you to one particular gliding club in Hampshire, partly because I know it best, and partly because it is impossible to take you to all of them, and rather dull to make up a sort of composite club. All the clubs differ from each other because of their situation—whether they are situated on a hill, or in a plain; and because of the different characters that make up the clubs.

We arrive after a drive through very pleasant open country, with some lovely views, because we have kept along a ridge of high land towards the plateau where the large disused wartime aerodrome lies. It is eleven o'clock on a Saturday morning, and as we approach a silver glider flies silently above us following the road, almost at the same speed as we are driving, but we lose sight of it when it turns in to land on the far side of a very large black building. That is the club hangar, but we turn in towards a low concrete building. It is being painted white by three people who are liberally covered with paint themselves, and are balanced precariously on erections of packing-cases and step-ladders.

Perhaps you are thinking that they look rather peculiar workmen, particularly as they are laughing rather a lot, and do not seem averse to flicking a brush at anyone who stands too near making critical remarks. They are, of course, ordinary club members, because practically all the work in gliding clubs is done by the members. It is the only way to keep the cost low enough so that you can learn to fly on your pocket-money. The three painters during the rest of the week are respectively a solicitor, a scientist and a typist.

In the clubhouse lunch is being prepared, and several other members are laying the tables. I show you which room is which, and then we go out to the launching point along the perimeter track of the old aerodrome. There is a west wind today, so the gliders are taking off from the eastern end of the main runway. At this moment a car flashes past us at an enormous speed, and you look quite astonished when you see that it is a very elderly Austin 7. Quite a number of these cars belong to members of the club, as they are cheap to buy and to run, but the long straight perimeter track past the clubhouse is ideal for finding out just how fast you can make them go.

As we walk along parallel to the main runway I point out a glider just about to take off. A signal light beside it is giving quick flashes to a winch at the far end of the aerodrome, and then the glider starts to move forward. It is an Olympia, painted blue and highly polished. To begin with it runs along the ground, and then takes off climbing gently until it has plenty of speed. Then it climbs steeper and steeper, with the launching wire curving away from its nose towards the far end of the aerodrome.

You ask if gliders always climb as steeply as this, because it does look alarming until you are used to it. As the glider gets higher, and nearer the far end of the aerodrome, the climb becomes less steep, and by the time the glider is nearly over the winch, it is flying along almost level once more. Then the pilot releases the cable, which falls to earth gently because it has a little parachute on its end. The glider turns away to the left about eight hundred and fifty feet up.

As we arrive at the launching point we can see several gliders parked. They are turned so that a wing is

pointing into wind, and this wing is then weighted down with a couple of old motor tyres.

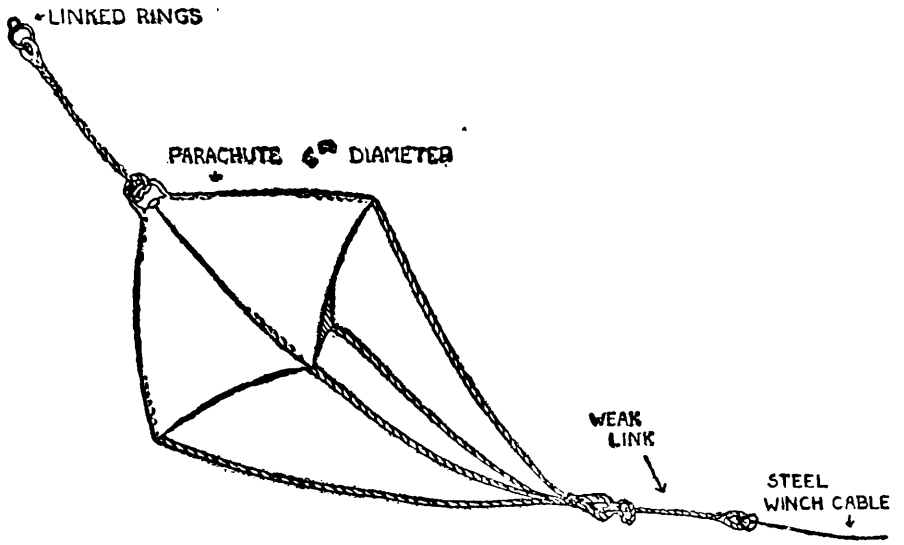
Two gliders are facing into wind towards the winch which you can see just as a yellow blob in the distance. One is a single-seater Prefect, which is a training glider for pupils who are able to fly solo. The other, called Daisy, is a big side-by-side two-seater of the Slingsby T21b type, with red wingtips for identification. Both gliders have their pilots already in them, with the safety harness done up over their shoulders, and are waiting patiently for the tractor to arrive with the launching cables. The winch has two drums on it, and both cables are pulled out across the aerodrome to the waiting gliders. The tractor drives between them, and the cables with their parachutes are taken off. One cable is pulled across to the left-hand glider, and the steel rings at its end fitted into the release mechanism near the nose of the glider. You hear the hooker-on shout "Open," and this is repeated by the pilot, as he pulls the yellow release knob in the cockpit. Then he calls "Close," and the pilot lets go of the knob. The hooker-on tests the rings to make sure they are in properly, and then stands clear.

Because the glider has only a single central wheel, it rests with one wing on the ground, but now someone holds the wings level, preparing to run with the glider until it gains enough speed to balance itself. The signal lamp flashes again and the glider takes off. As soon as it has finished its steep climb and dropped the cable, the second glider can be hooked on. You will notice that this cable-end and its little parachute just lay on the ground while the first glider was launched. It should never be hooked on or touched until the other launch is finished in case the winch-driver makes a mistake and pulls in the wrong cable, or the two cables foul each other.

The winch-driver is so far away that he cannot possibly see detail at this end of the field, so it is a rule that the second cable is left severely alone while the first is in use.

This time the two-seater is launched and you can hear the instructor talking to his pupil, as the glider goes up.

Now the blue Olympia comes in to land a little to our right. As it glided in you probably noticed some



Details of the glider end of the launching cable.

oblong shapes ride out of the top and bottom of each wing. Those are airbrakes, which, by spoiling the airflow over the wing, cause the glider to come down much more steeply and make accurate approaches easier.

We will go and help the others push it back to the launching point, and as we get closer you will see that the pilot has a transparent cockpit cover, and that the surface of the glider is very smooth and has no bumps or bulges which would obstruct the airflow and cause drag.

Some fine flights have been made in this type of glider.

For instance, one flew from Farnborough in Hampshire to Newcastle, two hundred and fifty-seven miles, reaching a height of twelve thousand feet on the way. It was a goal flight, too, which means that the pilot had declared in writing beforehand that he would go to Newcastle.

We will push the glider backwards; two people are lifting the tail, carrying it by two little handles. You can push on the leading edge of the wing, since it is plywood and solid enough, but you must never push on the thin trailing edge of the wing, as it is not designed to be handled and may be easily broken. The pilot is holding the wings level, so I will help you push. It is not difficult as the glider has a wheel, unless of course the grass is very soft and muddy.

After you have watched a few more gliders take off, climb steeply up into the sky, and then either find some upcurrents and start circling in them, or come in again and land, we might go and look at the workshops, and so start to walk back towards the clubhouse. Before we arrive, however, someone comes out and starts to ring a bell that can be heard from the launching point. Lunch is ready, so the workshops must wait.

We hurry so as not to get left well down the queue, and go to the counter and collect plates of stew and fruit and custard. You see a little notice which says, "Will all men please do five minutes washing up". That is because the women members take turns to be duty cook for the whole day, and it would be asking too much of them if they had to wash up fifty lunches as well, but it is soon done if enough men go in for only five minutes.

At lunch you will have a good opportunity to see what are the most sensible clothes to wear when gliding. It is often cold and very windy on the exposed aerodrome, and if you are out at the launching point all day, par-

ticularly if the ground is wet as well, you will want to choose your clothes carefully. It is by no means warm today, and you will notice that there are two different styles of fashion. These are not the differences between men and women members—out on the field they both adopt the same measures to keep out the cold and damp—but the difference between the short-jacket and the flying-suit schools of thought.

Dick, over there, belongs to the first. He is wearing long trousers and rubber boots, topped by an assortment of sweaters, and a ski-jacket which has a hood, which he pulls over his head when he is flying, or just to keep his ears warm on the ground.

Harry, on the other hand, wears one of those bluey-grey ex-R.A.F. flying suits, which are quite thin but windproof. The flying-suit boys, strange to say, usually wear shoes and not boots, and the absence of a built-in hood is made up for by a brightly coloured woolly cap with a bobble on top.

If you have finished we will take our empty plates back to the counter, and go on down to the workshops. As you are still a visitor I do not think it will matter if you do not help wash up today.

In the big rooms of the workshops, the gliders are overhauled, and at the far end the winches and cars are dealt with. As soon as we go in the door, there is a strong smell of dope, and you will notice that I stubbed out my cigarette before entering, as dope is inflammable. It is used for making the fabric covering of the glider smooth and taut and resistent to rain. It is brushed, or sprayed on, quickly because it does not take long to dry, and if you flick the fabric panels with your finger you will find that they make quite a "ping."

Every year each glider is brought into the workshops

and carefully inspected. Any part which shows signs of wear is replaced. About once in three years all the fabric is taken off the wings and tail and new material put on, which is what is happening to this single seater. You can see inside the wing now, and notice how all the ribs are built for lightness, so that you are not carrying unnecessary weight in the air. Every part of a glider is carefully calculated so that it can be built as light as possible and still have plenty of strength. Do you see those two people working on the wing, their fingers all covered with red dope? The girl is a hospital nurse, and the man a colonel in the army.

The glider fuselage on the far side of the workshop is part of an Olympia, and the legs hanging over the side belong to the upside-down body of Jimmy. He is twelve, and is very useful as he can get right down inside to deal with nuts and bolts which no adult can reach without training as a contortionist first.

In the far workshop there is a retrieving car completely stripped down to its component parts, and the engine is on the bench being reassembled. The M.T. committee have also found time to install a large stove in the corner, and sometimes in the winter brew tea and fry eggs when they feel peckish.

All gliding clubs in England which have no Government subsidy run on similar lines, and although most of the skilled work falls on the shoulders of fewer members than is really desirable, it is up to everyone to do as much as possible to help the club provide cheap flying. If you do not help with the work, it will have to be done by paid staff, and then gliding will cost more than you can afford to pay. Once you get to know people here you will have a great deal of fun, and soon find plenty to do as well as learn to fly.

CHAPTER TWO

A FLIGHT IN A GLIDER

You were very sensible to get a note from your parents before you came this morning giving you permission to fly, as no club, quite rightly, will accept the responsibility of taking you up without it.

The instructor says that the two-seater with the enclosed cockpit cover will be available after the next launch, and if we go and help push it back from wherever it lands, we will get it all the sooner. Look, it's coming in now, behind you. It is still nearly two hundred feet up, but the pilot is already turning straight into wind, and opening the airbrakes to steepen his angle of glide and so make the approach to his chosen landing place easy. In the old days, before all gliders were fitted with air brakes or spoilers, the pilot had to make S turns on the approach to help him lose height. This was always difficult for an inexperienced pilot to do properly, and could be dangerous if a number of gliders had to come in to land at the same time.

Now the two-seater—this one is called Rudolf, as its nose is painted red to identify it from the other two-seaters—has come over the hedge and the pilot is beginning to flatten out his glide before landing. He is trying to fly the glider along just above the ground while the speed dies away, until it is slow enough to land smoothly and gently. Now he is down, and not too far away. Come on, let's get it back quickly, so we can get the next launching cable before that Olympia which is coming in to land now.

You hold the wingtip. No, not that one. Always

take the windward wingtip, so that if the wind is strong it cannot lift the wing and blow the glider over.

Here we are, then, back at the launching point, and we will turn the glider into wind ready for take off. Will you get into the right-hand seat, as this is where you will be when you start to learn properly. Can you see out all right and reach the rudder pedals? Do up your four harness straps. First the left shoulder strap with the pin, then the right hand bottom strap on to it, then the left bottom strap, and finally the right top strap. Now lock everything by pushing that triangular wire thing through the hole in the pin. Good. Don't worry if the straps feel tight, it is really much more comfortable, although it may feel restrictive until you are used to it.

Here comes the winch cable now, pulled by the tractor. The steel rings in its end fit into the quick release under the nose of the glider. When Mike, who has unhitched the cable from the tractor, calls, "Open," I pull this yellow knob on the instrument panel, and he fits the little ring into the hole. When he shouts "Close," I let go of the knob, and the release closes. If by any chance I should forget to pull the knob at the top of the launch to free the launching cable, the release is so designed that it will automatically throw off the cable as soon as the glider starts to overfly the winch. For obvious reasons, you must not rely on the automatic release working, and you should always release the cable yourself at the proper time.

Now we are ready to go, there is a runner holding the wingtip, and a signaller ready with the Aldis lamp.

"Clear above and behind? Take up Slack."

The signaller repeats our words, and starts giving slow flashes to the winch with his lamp.

Can you see the winch cable pulling slowly sideways through the grass as it is tightened up? Now it is taut

and we are ready for the winch to pull fast, to get us into the air. "All Out."

You can just hear the faint roar of the winch engine at the other end of the field, as we start moving forward and rapidly gather speed.

Now we are off the ground, and can start to climb, not too steeply at first. You are probably finding the steep climb a strange feeling, but pupils very quickly get used to it and quite soon the poor instructor has to stop them trying to go up vertically.

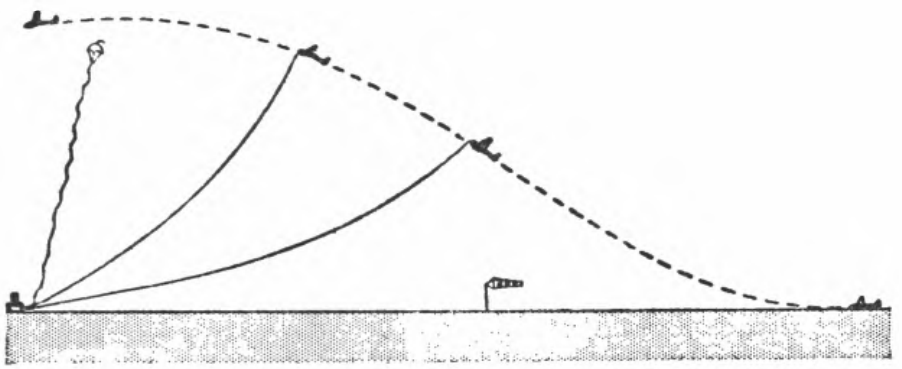


Diagram of winch launch seen from the side.

We are about half-way up the launch now—nearly five hundred feet, and if you look out sideways, you will see that we are getting a magnificent view of the countryside.

The air is fairly smooth today, which makes the launch very peaceful, but also means that there will not be much chance of finding any lift.

Now we are at nine hundred feet, and nearly at the top of the launch. Nine hundred and fifty feet—— Yes, just a thousand feet, and now I must release the cable, as the winch cannot take us any higher. We fly this glider at thirty-seven miles per hour, and are going to make a large circuit of the aerodrome.

Look towards the horizon where I am pointing. Do you see those faint blue hills? They are the Isle of Wight, and that strip of silver is the Solent.

Away to the east and south-east you can see Leith Hill and the South Downs. Sometimes on a clear winter day those north-facing slopes have snowy caps and look like miniature Alps from here. Far off in the opposite direction you can see the hills to the south of Newbury, and south of them the beginning of the rolling country of Salisbury Plain.

It is beautifully clear today, and from just one little winch launch we can peer into four counties.

It is a great pity that there is not much lift about, or else we might climb up and visit the clouds. Now we are down to six hundred feet, and you can see the other two-seater climbing up on the launch.

Just a moment! I am going to try circling here. Did you feel that faint ripple in the air; it felt like weak thermal lift, and the variometer—that's the instrument which tells us if the glider is rising or sinking—gave a little flicker of its green ball.

Yes, there is something here. As I circle very carefully, the green ball rises out of its tube to show that we are no longer losing height, but actually going up at about six inches per second. This is nothing compared with the great strong thermals that take gliders hundreds of miles across country, or high into thunderheads, but it will help us to stay in the air a little longer.

Do you see that the green ball only comes up for part of each circle and then sinks back as though it is too tired to bother? That is because the thermal bubble, or whatever it is, is to one side of us, and we are circling half in and half out of it. I am going to shift our circles a little towards that wood over there, and see if we can

get right into the thermal. Yes, that has helped, the green ball is now staying up for most of the circle, but it is very weak, and we are barely holding our own. Unfortunately the wind is drifting us away from the aerodrome, so if we don't want to have to land in a field, we must leave the thermal, such as it is, and go back into wind again. However, it has taken us back up to eight hundred feet.

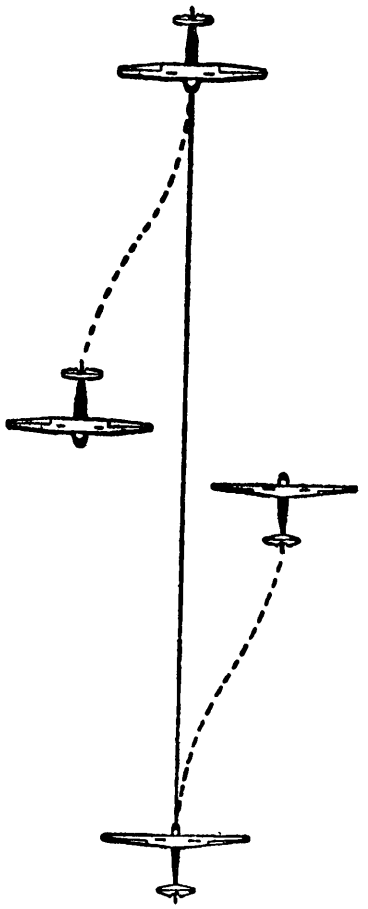
Look, the other two-seater has come over to join us, but that lift is too far from the aerodrome now to help any of us.

This is a good moment to teach you one of the most important rules of the air. When two gliders are approaching each other head on, as we are doing, each must turn away to the right. The other two-seater has started already. We will alter course to the right, too, and then we pass with plenty of air space. Remember that. Whenever you meet another glider turn away to your right.

As we turn again, you will see the whole aerodrome. The pattern of runways and oddly shaped patches of grass may look confusing at first, but you will soon be able to pick up where you are. Can you see those two red gliders at the end of the runway? We are going in to land on the grass to the right of them. We are less than four hundred feet now and in position to approach in to land. We must still keep an eye on the other two-seater, although we are well clear of it. Can you see it? No? It is away to our left, but quickly seeing other gliders takes quite a lot of practice.

Now I am turning into wind for the final approach. We are fairly high, but I am going to open our airbrakes to give us a steep easy approach. As we get close to the ground, I begin to check our descent, and then try to

keep the glider just off the ground while the speed dies away. There we are, on the ground, but I must still use the controls to keep straight, and to keep the wings level until we have stopped.



When two gliders are meeting head on, each alters course to its right.

This time we will not have to push the glider back, as I have landed it at the launching point, so we will just stay in the cockpit until the next pilots are ready to take over.

Do you see that Olympia being launched now? The

signaller is not using the lamp, but a bat. This is an alternative method. Notice that when he wants to give, "Take up Slack," he waves the bat to and fro in front of his knees, and for "All Out," he waves it above his head. If he wants to signal "Stop," he holds the bat steady above his head. The equivalent light signal is a steady light continuing until the glider pilot has released the cable and the winch has stopped. Anyone may shout to the signaller to stop the launch and he must obey immediately. Perhaps someone has noticed that the glider tyre has suddenly gone flat, or a dog or a person is straying across the winch cable. It is always better to have a few delays than to let a glider be launched when something is wrong.

Here are the instructor and pupil for the next flight in this machine, so we will get out now, and if you are not in a hurry to go we might talk a little about how a glider flies.

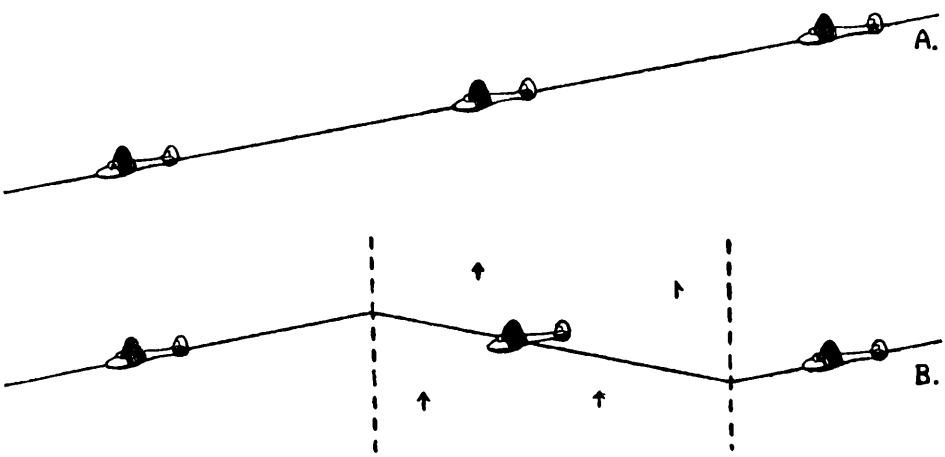
As you probably know, the wings can only provide lift to carry the glider when the air flows past them at more than a certain minimum speed.

If, in the air, you should fly at less than this speed the airflow over the wings becomes disturbed, and the wings fail to produce enough lift to support their load any longer. When this happens the glider stalls, and falls nose downward, until it has gathered enough speed for the airflow over the wings to become smooth again. The stall is usually very mild indeed on gliders, and there is usually plenty of warning beforehand, too, so there is no excuse for stalling by mistake.

The aeroplane has an engine which pulls it through the air in level flight fast enough to maintain the lift over the wings, but since the glider has no engine it can only maintain the necessary speed by always gliding downhill.

If you are free-wheeling a bicycle downhill, and then the road becomes level, the speed you will have attained will carry you along the level road, but once there you will gradually get slower until you stop.

If you try to fly a glider level, you will also gradually get slower until you stop—or stall. So when you are flying a glider remember that you must go steadily downhill all the time, and even when you go through bubbles of rising air, you are still gliding downhill. The slope of the hill is pretty flat, because glider designers have tried hard for years to make gliders with as good a performance as possible, by saving unnecessary weight, cutting down drag, and using very efficient wing sections. Twenty years ago gliding angles of 1 : 18 were usual. This meant that they had to fly down a hill as steeply as this to maintain enough speed to go on flying. Now the gliders which go in for championship flying have gliding angles of over 1 : 30, so they do not need to fly downwards at all steeply to maintain their speed. The better the gliding angle, the further you can travel from



A. Normal glide path of glider.
B. Glider gains height gliding through rising air.

any given height, or if you look at it another way, the longer time you will have in the air to search for more lift.

When you find lift, as I said just now, you still fly downhill, and if the air you fly into is going up faster than you are travelling down, then you will gain height. When we gained that two hundred feet just now, you probably noticed that we altered neither our speed nor the attitude of the glider. We just went on going downhill, while the rising air carried us bodily up.

If you find this difficult to visualise, the next time you see an escalator, run down it, and say to yourself, "I am a glider gliding down at a steady speed"; then try to run down an *up-going* escalator (but not at rush hour!), and before you get out of breath say to yourself, "I am now a glider flying in strong lift."

CHAPTER THREE

LAUNCHING METHODS

YESTERDAY you saw some gliders being winch-launched, as well as having one yourself. Today I am going to tell you more about winch-launching, and what other methods are used to get gliders into the air. Let's walk over to the winches now.

The earliest winches were simply cars which had their back ends jacked up, and one driving-wheel replaced by a drum of cable. When you ran the engine in gear, the drum spun round, and wound the cable in, pulling along the glider attached to its far end. If the glider climbed as it was pulled along it went up, as we did yesterday.

Nowadays we have winches especially designed for the job. They have engines of 85-120 h.p., and two big drums of stranded steel cable of about twenty-five hundredweight breaking load, which can be driven by the engine in turn. This cuts down costs and time, as you can pull two cables out to the launching point together, then launch two gliders one after the other, and then pull the cables out again. With a single drum winch, the car has to make the journey to the launching point in between every launch, thereby wearing itself out faster, and using a lot of extra petrol.

The modern winches also have automatic pay-on mechanisms which distribute the cable evenly over the surface of the drum, which avoids tangles and unnecessary wear, and they also have a guillotine which can sever the cable instantly in an emergency.

The winch-driver sits in a cage, so that if the cable should break during a launch, it is not possible for a loose end to fly back and injure him. He is a very important member of the gliding club, as good launches given quickly and efficiently help the flying to run smoothly and the club to pay its way. Winching is a skilled job as well. The driver has no instrument to tell him how fast the glider is going. He has to judge all the time from experience whether the speed of the glider is right, by assessing the strength of the wind, by looking at the glider, and by acting promptly on any signal given by the pilot. If the glider is being launched too slowly, the pilot waggles his wings, but if it is being launched too fast, he yaws the glider from side to side with the rudder.

In between your flying lessons you can always come up to the winch and stand beside the driver and start to learn about winching. Then after you are solo, you will be ready to be trained properly as a winch driver.

Today we have about one thousand yards of cable out across the field to the launching point, and usually the gliders get in height about one-third of the length of cable out. So with one thousand yards, the gliders should get about one thousand feet in height. One thousand yards is quite a long way, and it is very difficult from the winch to see what is going on at the launching point. The driver has to rely absolutely on the signals given by the signaller. He cannot see if there is someone standing in front of the glider to be launched, or even if there is a pilot in the cockpit. That is why it is not only very important to give signals properly and at the right time, but also never to hook on the launching cable until the pilot is ready. Having once seen a glider launched without a pilot in it, I can assure you that it is

only funny for a very few seconds: after that, it becomes unbelievably expensive. Fortunately it was not my glider.

There is another method of launching which is very similar in result to winch-launching, and that is auto-towing. We also do auto-towing here, and it has several advantages over the winch, but it cannot be used everywhere as the car which tows the glider instead of winding the cable in on a drum, must have a smooth surface like a runway. A winch, on the other hand, can give launches over most unsuitable surfaces provided that there is enough smooth ground for the glider to take off from.

The car needs to have about the same power as the winch, and should have a clear rear view for the driver, or his mate, to observe the glider. It has no drum, but a simple quick release on the back.

Usually for auto-towing piano wire is used instead of steel cable. It is much cheaper, but cannot be used on a winch as it will not wind on a drum properly. The auto-tow wires are usually parked alongside the edge of the runway at the end of a day's flying, with a tyre or something on each end to keep them out straight.

Tow-car driving is a skilled job, but although it seems easier to judge the glider's speed, it is more difficult to keep the wire from kinking after the glider has released. It also requires the skill, of doubtful merit anywhere else, of being able to drive fast and straight, while looking backwards.

When auto-towing is being used alongside winch-launching, there is no great difference in the height obtained from either method of launch, although auto-towing usually gets the glider a little higher, and certainly gives a smoother launch. It also gives a quicker turn

round, or rate of launching. Its disadvantage is that unless a really smooth level surface is available, the tow car, which really has to be driven fast and hard, will disintegrate in a short time.

If two launching lines are being used side by side close together, it is wise to launch only one glider at a time, as the risk of collision, unless the pilots are highly skilled, is too great. On the other hand, if two winches, or a winch and the end of the tow-car run are at least two hundred yards apart, launching can go on simultaneously even if the glider launching points are close together. This is called divergent launching, and enables a busy gliding club to pack in more launches to the hour and therefore train more pupils. At the top of the launch the gliders turn away from each other and do their circuits of the aerodrome in opposite directions.

If the wind is very strong it is possible, when winch-launching, to adopt a technique known as kiting.

On days when the wind at a thousand feet is over 40 m.p.h. the winch engine will be just idling by the time the glider reaches what is normally the top of the launch, and the cable will still be taut as the glider is now behaving like a simple kite. If the winch-driver then slowly pays out the cable from the drum by easing off the brake, the glider will rise, and continue to keep the cable taut. This can be continued until the glider is carrying such a great weight and drag of cable that it will not go any higher, or until the winch-driver absent-mindedly pulls the end of the cable off the now empty drum. If this occurs the glider will immediately start drifting backwards, but so would about three thousand feet of cable which would then be automatically released from the glider if the pilot did not do this first. The winch-driver would be well advised to emigrate, as the job of disentangling

the cable from the top of the nearby forest would hardly make him the most popular man in the club.

This excitement has not yet occurred, and I am sure you are much too sensible to let it ever happen to you.

But, joking apart, gliders have kited up to over three thousand feet in very strong winds. Unfortunately very little useful instruction can be given under such conditions, as unless the glider is kept flying steadily into wind, it would soon be drifted out of reach of the aerodrome.

Another method of launching which we use here is aero-towing. Any suitable light aeroplane of about 90 h.p. or more, with a properly designed release fitted to its tail, can be used. We have a Tiger Moth, which is very good, but is not easy to manœuvre on the ground without assistance in high winds as it has no wheel brakes or tail wheel, and it may have to stop flying when gliders with experienced pilots can safely continue.

The glider is attached to the aeroplane by a tow rope of about two to three hundred feet in length, although ropes both longer and much shorter can be used for special purposes.

The tow rope can be of steel winch cable, piano wire, auto-towing cable, hemp or sisal rope, or nylon. Quite the most pleasant smooth tows are obtained from nylon rope, and this material has the added advantage that, unlike hemp or sisal, it does not suffer from lying in the wet. Steel wire gives a harsh tow and in rough weather it is impossible to avoid unpleasant snatches. It is a barbaric material for aero-towing and should be avoided.

In each end of the tow rope there are similar linked rings to those on the winch cable. One of these goes into the nose release of the glider, and the other into the tail release of the aeroplane. Similar signals are given

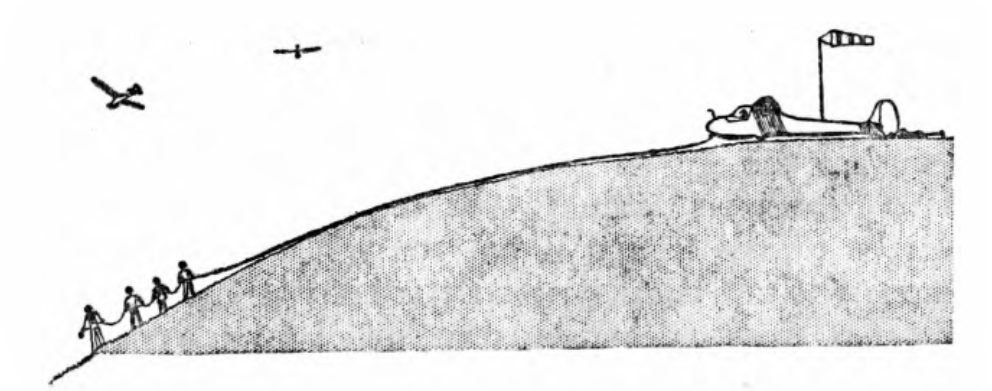
as for any other method of launching, the slack is taken out of the rope, and then the aeroplane opens it's throttle fully and takes off, the glider inevitably following behind.

The aeroplane flies fairly slowly so that the glider is not being pulled faster than is comfortable, usually about 60–65 m.p.h., and climbs up in search of lift. This is the great advantage of aero-towing over winch-launching. The aeroplane can take the glider to good-looking cumulus clouds, or signal it to release in a thermal into which the aeroplane has flown. If necessary the aeroplane can go on flying around towing the glider, until good lift is eventually found. As with the use of oxygen for the Everest climb, you will always find the purist who says that aero-towing is not fair, and that the glider pilot should find his own lift. I do not propose to get involved in either of these controversies here, but I do know that I have only so much money and so much time, and any reasonable method which enables me to get more fun and more experience out of what I am doing, I shall certainly use.

Unfortunately aero-towing is more expensive than winch-launching or auto-towing, and is used by the ordinary club members mostly when it is difficult to contact thermals from a low height, or for being retrieved at the end of a cross-country flight. If the glider has landed in a very large field or aerodrome, being towed home often means a night's sleep, or turning up at the office on Monday morning on time, whereas retrieving by car takes appreciably longer! Another use for aero-towing is towing up gliders for their initial test flights, and for the delivery of gliders abroad. It is a very safe and easy method of launching, and in some countries is a requirement for the elementary solo flying test.

There is still another recognised method of launching which we do not use here, although when the club gliders go away to explore new hills and mountains on expeditions, they use it. This is Bungey launching, and is a method of catapulting the glider off a hilltop with a rubber rope.

It is great fun, and looks very easy, but like all things

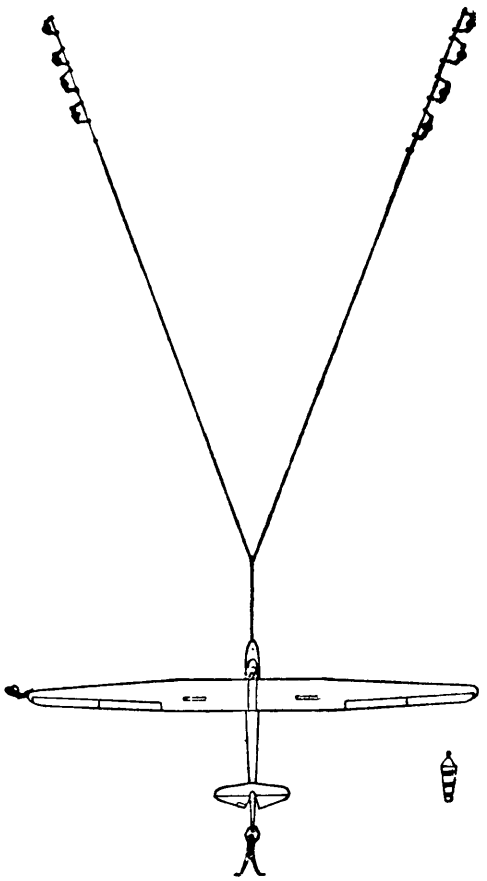


Side view of Bungey launch.

in any sort of flying, must be done properly if the results are not to get more exciting than is desired.

The method of launching is as follows. The glider is faced into wind on the hilltop, far enough back from a smooth rounded edge so that the bungey—the rubber rope—can be laid out like a short stemmed Y from the glider's nose. The ring at the foot of the Y is hooked on to an open hook under the nose of the glider, and a crew of at least three people take hold of the hand rope at each end of the Y's arms. Meanwhile some wretched club member lies on his tummy on the wet grass to hold back the tail, while the rubber rope is being stretched. Someone else holds the wingtip and gives the orders. When he says "Walk," the two crews walk off down the hill with the bungey, and as soon as it starts to stretch, the

man at the wingtip shouts "Run." The two crews, hanging on to their ropes, now rush down the hill face for all they are worth, and the man holding back on the tail gets longer and thinner, particularly if some other "helper" is sitting on his legs.



Plan view of Bungey launch.

Finally, just before the holder-back on the tail snaps in two, the wingtip man shouts "Let go." This produces relief for the tail man, but often means that the two crews, now relieved of the load of the glider, which has shot into the air over their heads, hurtle in an uncontrolled

manner even further down the hill, up which they must toil in order to launch the next glider.

Before we leave this subject of launching methods, there is one small point which I must tell you about. For obvious reasons the launching cable, whether for winch, car or aero-towing, should be weaker than the glider, so that it would break first if anything should go wrong. This is achieved by using a strong tough winch cable, but between the end of the cable and the linked rings for the glider's release, there is inserted a short length of wire or rope of the required strength only, which is known as the weak link, and which can be easily and simply replaced when it shows signs of wear.

CHAPTER FOUR

SOARING

Do you remember our talk about how a glider flies, and how it always has to fly a downhill path in order to maintain enough speed to go on flying? And do you remember, as well, that when we circled in that patch of lift on your first flight, we were carried up two hundred feet, although we were still gliding down in exactly the same way? We were gliding down *through* the air, but as the whole patch of air that we were in was going up faster than we were gliding down, we gained height.

The patch of air which took us up is called a thermal, but thermalling is only one of several ways of staying up that we now know about.

In the early days of gliding, the various methods of soaring had yet to be discovered, and it was only thought possible for gliders to be carried to the top of a hill and then fly down to the bottom again. Some people scornfully called it aerial tobogganing.

I am going to tell you how soaring started and how it has progressed, because the different methods were not all discovered at once. It is a story of exploration and great courage, and in the very early days many of the pioneers lost their lives finding out the hard way what you can do easily and safely today.

I suppose it really started properly about the time that your grandfather was a small boy. A man in Germany, named Lilienthal, built a pair of wings with a

little tail attached, which he would hoist on to his shoulders, and then run against the wind, until the wings lifted him off the ground. He built an artificial hill to run down and jump off in order to obtain longer flights, and he made a great many descents from the top of his little hill before he was killed. On some of these descents his glider did not come down quite so quickly as on others, but no one really understood why.

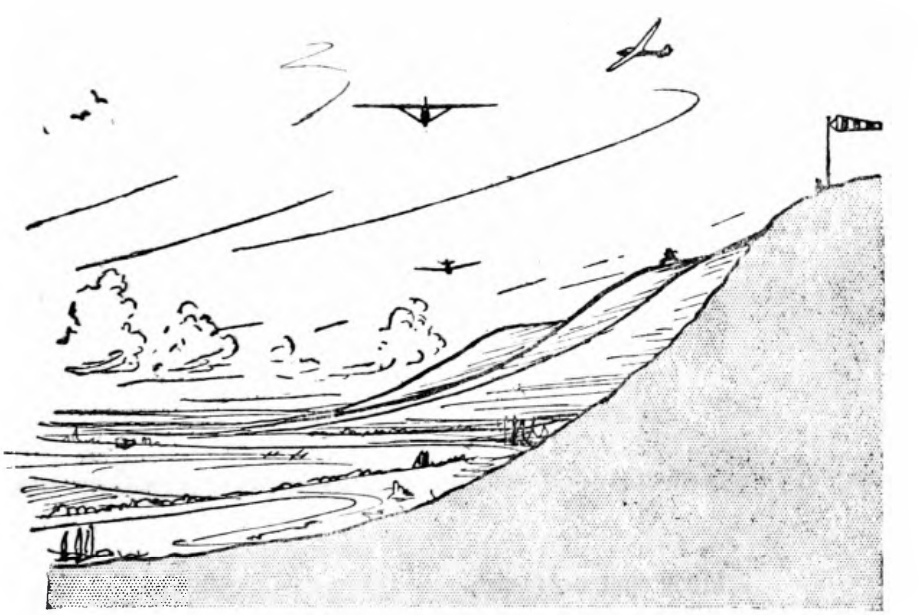
Nothing much happened after this for a very long time other than some similar experiments by the English pioneer Percy Pilcher, until the 1920's, when gliding restarted in Germany. Again a hill was used, largely so that the glider could have a longer flight before it reached the valley floor than would be possible from a level field. Winch-launching and aero-towing had not been thought of, and the bungey was about the only satisfactory method of launching in use.

One day, when some pilots were indulging in the tedious process of launching the glider off the hilltop, flying it down to the valley, and then carrying it all the way back up again, one of the pilots, after being launched into wind in the usual way, turned along the slope, and noticed that he was no longer losing height. Quite soon, of course, he reached the end of the slope, and flew out into the valley and landed at the bottom as usual. But what had happened? How was it possible, when flying along the line of the slope, that the glider did not sink down so quickly? Did the wind, when it hit the range of hills neither stop nor go round them, but actually blow up the face of the slope and over the top? And was it possible that the glider had been supported sufficiently by this wind to enable it to maintain height? As you can imagine, it was all very exciting to the pioneers in their crude gliders, and they

lost no time in hurrying back to the top of the hill to experiment again, and again. They dared not let themselves think that if the air could produce enough power to enable them to keep their height, it might even be possible to soar, and to go higher and higher like the birds.

It was not long, however, before enthusiastic experiments had shown that a considerable area of lift did extend above and slightly in front of hills when the wind was blowing against them. The lift from the rising air in this region was not only enough to support the weight of the glider and its pilot, but in a strong wind to carry him up to as much as two and a half times the height of the hill.

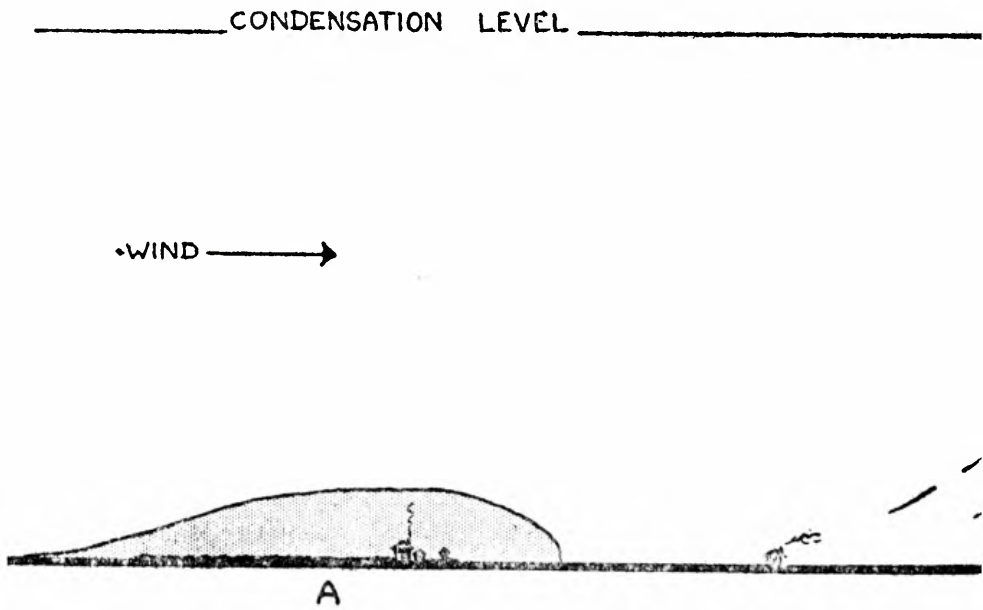
You can imagine how this discovery helped the pioneers. Gliding was regarded by the world as not worth serious thought, but now it was possible to make extended flights even though only in a limited region.



Hill soaring.

Shortly the day came when a schoolmaster flew a glider of primitive design for over six hours above the hilly sand dunes on the Baltic.

Thereafter competitions were held, and prizes won for flights of many hours' duration. These flights, and the interest they attracted, brought about a rapid development in the design of gliders, which became slender birds of huge span and low wing loading, designed for floating for hours in even the weak lift of very light winds. But then pilots once more began to feel the limitations of their sport. From high over the ridges and mountains, they could see the far countryside, but they were tied to the area over the hill. To leave it meant an inevitable landing at the bottom.

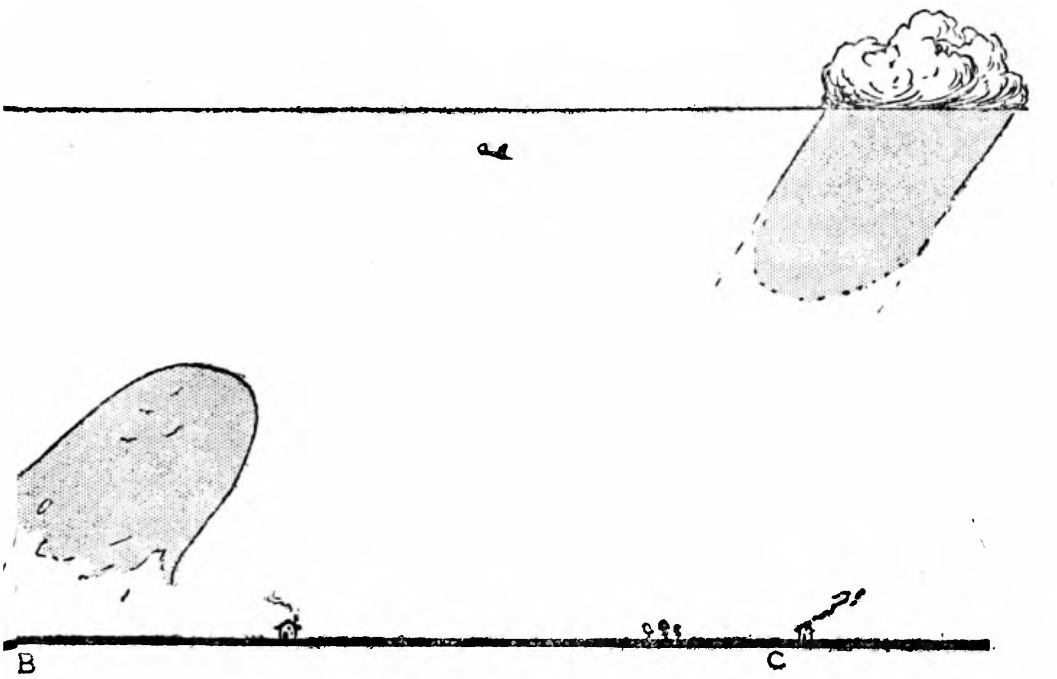


How thermals start.

A. Patch of air gets warmed.

B. Becomes unstable and starts to rise.

But one day in 1928 a pilot discovered that in warm sunny weather it was possible to find places over the hill where the lift went much higher than usual. These areas of extra lift were not large, and required the glider to be continuously turned, or circled, to keep within their boundaries. Sometimes birds could be seen circling in them as well. But birds could also circle and go up out over the valley. In the heat of the day the storks would circle lazily upwards until they were almost lost to sight in the deep blue. Might it be possible that these patches, or bubbles of lift which mingled with the hill lift on warm sunny days, existed out over the valley and the flat land as well? Amidst a certain amount



C. Reaching condensation level and forming cloud.

Time from A to C approximately 10 minutes.

of doubtful head-shaking one or two pilots decided to test this theory and were bungey-launched off the mountain top and flew straight out over the valley—and they found lift.

Once more the enthusiasts experimented with the new phenomenon. Sometimes they failed, but sometimes they succeeded, and after circling up in one patch of this strange rising air, set off and found another one a few miles further on. At last the far distance lay before them. They were no longer tied to the hills and mountains. Flying across-country had become a reality. But how did this strange form of up-current work? I will try to tell you very simply.

On hot sunny days the surface of the earth warms up, but unequally. Your bare feet will tell you this if you walk from grass on to a tarmac road on a hot day. The warmer patches on the ground such as cornfields, villages etc., warm the air immediately above them more quickly than do woods, or lush green meadows. These patches of warmed air are unstable and seek to rise, because, as you have learnt at school *hot air rises.* The cold heavy air always tries to sink back to earth, and the warm light air wants to go on up.

Once one of these patches, bubbles, or agglomerations of warm air, has started to rise, it will go on doing so until either it has cooled down to the same temperature as the air surrounding it, or it rises into an unexpected layer of warmer air up above known as an inversion. Then this up-current, or thermal bubble, will stop rising, and if it contains a glider pilot, busily circling round and round to keep within its confines he will have to go and look for another one. By this means of thermal soaring, cross-country flights of hundreds of miles have been made.

This new discovery also affected the design of gliders. The huge slow machines gave way to gliders of smaller span which had better controls and were much more manœuvrable for searching out and circling in small thermals.

As the pioneers began to develop the technique of climbing in thermals, they soon discovered that the puffy cauliflower-like cumulus clouds that floated gently across the sky on fine warm days lived at the top of the thermals. Every cumulus was the visible top of a thermal, although not every thermal had a cumulus, as some of them were not warm or strong enough to reach the level at which cloud would form.

Quite quickly one of the more adventurous of the pioneers discovered that not only did the lift extend to the base of the cumulus, but up inside it as well. But now came the great problem. Blind flying not only required a special new technique but also complicated instruments, which on aeroplanes were usually driven by the power of the engine.

Continuous circling to keep in the often small areas of lift inside cloud demands skill of a high order, and when pilots first started exploring the roaring turbulent dark insides of thunderstorms, designers had to think seriously not only about the strength of gliders, but their stability and ease of handling as well.

Some of the pioneers were killed when their gliders broke up inside thunderstorms. They jumped out by parachute, but the lift inside the cloud was so strong that instead of coming down they were still sucked up higher and higher, and frozen to death in the snow and hail of the storm.

Nowadays gliders are built strong enough to withstand the most violent gusts, and have all the necessary

equipment for any form of soaring, but the pioneers, as they slowly discovered one means of soaring after another, were not so lucky. They explored the unknown sky with whatever glider they happened to be flying at the time, however unsuitable. You have the benefit not only of their discoveries of hill, thermal and cloud soaring, but of gliders which have been carefully designed and built to be excellent for the job. Pilots have now flown five miles above the earth in thunderstorms, and over five hundred miles across country in thermals and ordinary cloud lift. Soaring technique has developed to the extent that on a fine sunny week-end in the summer in England, it is quite possible to fly to another gliding club and return home, either with or without landing. It is possible to fly cross-country against the wind, and across wind, as well as just downwind, and in competitions most of the flights are set tasks, of which a high proportion are races. These are often won at an average speed of 40 m.p.h. or over.

As we have been talking about methods of soaring, largely on a historical basis, it would not be right to omit the early developments in this country in 1930–1935. Two pioneers should be particularly mentioned. Eric Collin, who accomplished the first thermal cross-country flight ever made in England at Huish (Wiltshire) in 1933, a distance of six miles. He went on to push this record up to ninety-five miles next year, when he flew from Dunstable to Holkham Bay in Norfolk. He was tragically killed in 1935 giving an aerobatic display.

The other great pioneer is P. A. Wills, who year by year since he first started in 1932, has done his utmost to bring British gliding to a position of prestige and achievement, and in 1952 was rewarded by winning the World Championship for Britain.

There is still one more known form of lift used by glider pilots which I have not mentioned. The discovery of hill or slope lift that we have talked about came as the result of launching gliders into wind off hilltops so that the flight might be longer than from flat ground. Thermals were discovered largely as the result of gliders being able to make hill-soaring flights of long duration and so enable the pilots to learn more about the feel of the air in which they flew. Cloud soaring followed logically from thermal soaring, and all these three methods of soaring were fairly easy for the pioneer to understand, although their practical development took, naturally, a long time.

Once you have started to think about it, it is really quite simple to realise that when the wind blows against a range of hills, it will be much easier for a great deal of the air to rise up over the top, than for it all to try to squeeze past the ends of the range. As soon as pilots found that they could soar in this rising air over the hill, they also discovered that if they got too far behind the crest or over the top of the hill, the air started flowing down again, and there seemed to be as big a down-draught behind the hill, as there was lift in front. So the air to the lee of hills was shunned, and such region in mountainous districts regarded as dangerous.

In several places the air is known to pour down the lee faces of some hills and mountains with such force that crops cannot grow there. There have been tales told for hundreds of years about the west face of Cross Fell in Cumberland when the wind is blowing strongly from the east. Cabbages have been torn from the fields by the force of the wind sweeping down the hill face, and riders blown from their horses.

But it was only over a few hills or mountains that

the wind hurtled down with such ferocity as this. Something peculiar was happening which was difficult to understand. Sometimes strange cloud formation like bars or elipses appeared in the sky above these windy torrents, and then it was noticed that whereas the wind blowing down the slope was of fantastic force, if one went further from the hill, one might suddenly walk into a region of absolute calm. What had happened to the wind? That immense rush of air could not just stop, it must have gone somewhere? How and why did the strange clouds form, and why did they not drift away on the wind like any other cloud?

Once again gliding was on the edge of a new and great field of exploration. After the air had poured down the mountain face, perhaps it bounced and went up, setting up a wave motion in the air? That would help to explain the area of calm, and the strange stationary bars of clouds.

In 1935, in Germany, gliders were towed by aeroplane into the region where it was hoped and calculated that the upward bounce of one of these strange lee waves would take place. The gliders released at 2,600 feet and finding smooth strong lift rose majestically to 4,600 feet, in air which by accepted ideas at the time should have been going down.

In 1939 a young English pilot, N. McClean, with a type of glider which is now used only for training, was launched by winch into the estimated area to the lee of the cascade of air down Cross Fell. After meeting violent turbulence and being nearly forced back to the ground, he found the lift, and soared to nearly eleven thousand feet, having a struggle to get down again before dark.

In the United States, at Bishop, California, a wave system has been discovered in which gliders have risen to forty-four thousand feet, after being aero-towed to

about twelve thousand feet. The world's record for height is now held by a wave flight, but the heights obtainable at Bishop bring in big technical problems which include pressurisation as well as oxygen for the pilot. But please do not think that all this is making gliding too complicated. You do not have to go to Bishop or soar in thunderstorms. You can spend all your flying life ambling up and down the local hill, or soaring about in a gentle summer evening thermal, if you want to.

But gliders are wonderful instruments for research, and I hope that in telling you about how the different methods of soaring were discovered I have shown you that glider pilots have found out a great deal about the air that was not appreciated properly before. Being comparatively cheap and transportable, gliders can be taken into mountainous districts where airliners have either crashed or found dangerous turbulence, and used to measure the extent of the air currents found, afterwards landing in some little clearing in the valley.

The different methods of soaring have also stimulated aerodynamic and structural research and development. Dive brakes which were originally developed on gliders for limiting the maximum speed, are now incorporated on all modern fighters. I do not wish to suggest that none of these developments would have taken place without gliders; they probably would; but almost certainly not so cheaply or quickly.

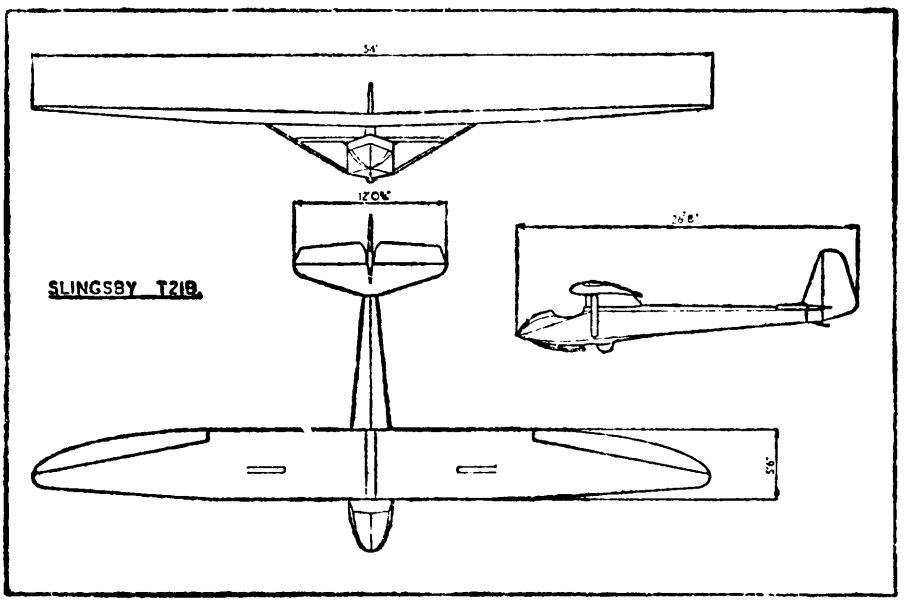
But research into different methods of soaring has by no means reached its end. As the early hill-scraping pioneers had not found out about thermals, so there is a great deal going on in the air that we still do not know about. I might even start muttering about Jet Streams if I knew anything about them. Or shall I leave that one to you?

CHAPTER FIVE

GLIDERS AND INSTRUMENTS

As the weather is wet, perhaps you would like to have a look round the hangar and see the different sorts of gliders that are in use so that you will be able to recognise them.

Here is the two-seater that you flew in; it is a Slingsby T21b, and called a Sedbergh by the A.T.C. There are probably more of this type of elementary two-seater in existence than any other. It is an extremely good machine for the job as it combines pleasant handling characteristics, good controls, and a gentle stall, with a



The T21b or Sedbergh training two-seater.

fairly low sinking speed, so that on an ordinary winch circuit without lift there is time for the pupil to have a useful lesson. It has a span of fifty-four feet, is twenty-six feet long, and weighs empty six hundred pounds. The gliding angle is 1 : 21, and the sinking speed 2.8 feet per second.

Like most gliders in use in England it is made of wood, spruce for the internal structure, and birch plywood for the skin. Aft of the spar the wing is fabric-covered, although on some gliders the wing is covered with plywood all over. The tailplane and the rear part of the fuselage are also covered in fabric for lightness. The metal fittings are of mild steel, and the skid and landing-wheel are built very strongly to enable pupils to learn to take off and land without too much worry.

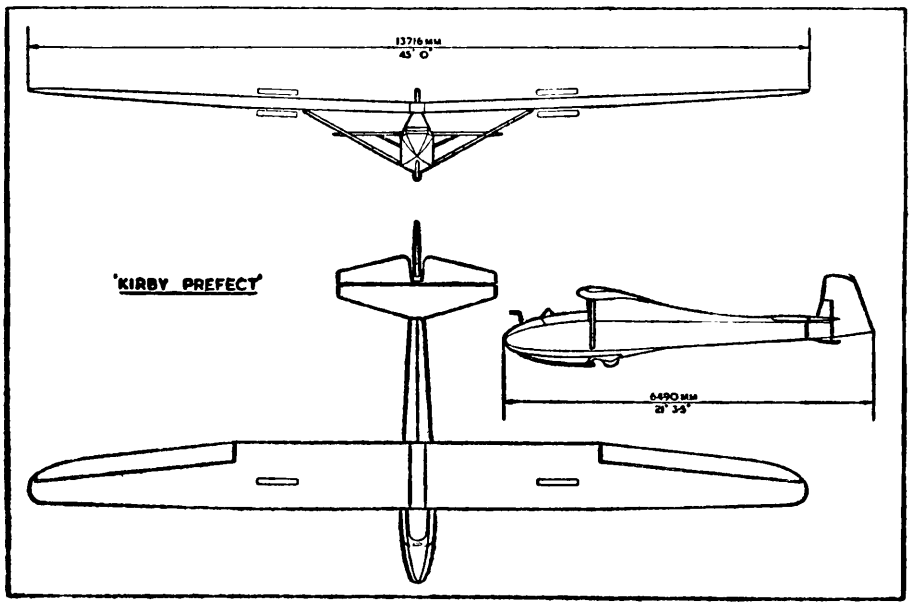
We send people solo on the two-seater, with a lump of ballast to compensate for the weight of the instructor. As you can see, this two-seater is a high-wing machine. While most aeroplanes are of the low- or mid-wing configuration, gliders are mostly high- or shoulder-wing designs. This is because the much greater span of the glider, combined with a simple central wheel, makes it easier accidentally to touch and possibly damage a wing-tip on take off and landing, and thus the higher the wing can be raised off the ground the better.

Gliders have a narrow wing of large span, as this has been found to give a much better performance than a short broad wing. This relation of span to chord is called *aspect ratio*, and gliders have high aspect ratio wings (high span dimension to chord). This means that when a chord of say three feet is divided into a span of sixty feet, the aspect ratio is twenty. On high performance gliders the Aspect Ratio is in the region of twenty-five. Very long thin wings are more costly to build than shorter

thicker wings, and so if really high performance is not necessary, the Aspect Ratio need not be so high. The two-seater trainer is eleven.

After you have done a few solo flights on the two-seater you will be converted on to the single-seater Prefect.

This glider is smaller than the two-seater T21b, having a span of forty-five feet and a length of twenty-one feet.



The Prefect single-seater soaring trainer.

The weight empty is 390 lb. and the Aspect Ratio is thirteen. The gliding angle and sinking speed are 1 in 21 at 45 m.p.h., and 2.7 feet per second at 36 m.p.h.

When we flew in the two-seater you will remember that we opened the spoilers or airbrakes when coming in to land, in order to steepen the glide and make our approach easier. The difference between the brakes on the two-seater and on the Prefect is this. On the T21b the spoiler is designed to help you to land only, but on the

Prefect it has another use as well. If you get out of control in cloud, you can open the brakes, and then even if the glider dived vertically downwards it would not be able to go fast enough to damage itself.

The airbrakes on the T21b are not designed to limit the maximum speed, and this is not really necessary as the glider was designed only as an elementary trainer, and if you try to make every type of glider do all the different jobs of training, cloud soaring, etc., they become much more expensive and heavy than is necessary. The true name of the brakes on the T21b is spoilers, and this means that they are a landing aid only. They just spoil the lift. The name of the brakes on the Prefect is dive brakes, and this means they are speed-limiting brakes, as well as a landing aid.

When you learn to fly gliders, you may find your instructor calling both spoilers and dive brakes, just brakes, and in the sort of flying that you will be doing for some time, their effect is much the same.

The Prefect has a good enough performance to do local soaring and cross-country flights. It is safe for cloud flying and aerobatics except slow rolls and bunts. You will find that very few gliders designed for high performance soaring will be capable of doing slow rolls. Large span and rapid rate of roll do not go very well together.

After you have done quite a lot of flying on the Prefect or such similar types as Grunau, or Tutor (which is not fitted with brakes), you will be given some more dual checks to see that you have not got in to any bad flying habits, and then converted to an Olympia, or a Skylark, or some glider which has a really good performance, and on which you could, if you became really skilful, break the U.K. local records.

In gliding the pilot is still a great deal more important than the machine, and a first-class pilot flying one of these gliders could easily beat a super high-performance glider flown by a mediocre pilot.

Fortunately gliders have not yet reached the stage where the pilot is just a machine operator, working to a drill which will use the glider correctly and efficiently. The glider is still the tool and the pilot the craftsman.

During all your training and early flying you must try to fly your glider with the utmost accuracy, as this is the first step to becoming a good soaring pilot. In an aeroplane with a powerful motor minor discrepancies in flying technique are not noticeable, and do not affect the performance to any extent. But in your glider, any misuse or excessive use of the controls, any slight crablike flying, and you will spoil the performance of your tool; you will be gliding down slightly steeper, sinking slightly faster than you need, and as a result you may not reach another thermal before you are too low, or you may even miss realising that you are on the edge of more lift owing to poor flying.

Gliders like Prefects, Olympias and Skylarks, are very pleasant to fly, and they will put up with a great deal of mishandling without complaint. As a result you will probably feel that you are really becoming quite a good pilot, because flying a nice aircraft gives you confidence and pleasure. Only by remaining critical of your own flying and trying to find out as much as possible about your glider, and then flying it always as well as possible, will you get the most from it, and use it as it should be used.

Now that designers know a great deal about building efficient gliders, more two-seaters are being built. In the past it was difficult to make a two-seater with as good a

performance as a comparable single-seater. Now there is no reason why a glider flying two up should not be as good, or even better, than the single-seater, and for little increase in size, weight and cost.

In a few years' time two-seater gliders will replace many of the single-seaters in use today, because flying across country, and exploring the sky, can be much more fun shared with a friend than done alone.

The Slingsby T42 tandem two-seater is designed for soaring training and cross-country flying, and has slightly swept forward wings in order to give the man in the rear cockpit a better view. It is very pleasant to handle in the air. The span is fifty-eight feet, length twenty-six, weight empty 740 lb. The gliding angle is about 1 in 28 and the sinking speed 2.4 feet per second.

New materials are being introduced into glider construction, as well as new methods of building. For instance, until recently the nose of a wooden glider, because of its smooth double curved shape, has been built up from numerous small pieces of plywood. Now it can be built in fibre glass more easily, and repairs are quite simple. The whole nose and cockpit can easily be built of glass, and used as a fabricated unit complete with controls and instruments either for replacement on a damaged glider or for use in glider construction kits.

Other new plastic materials will be introduced as they pass the rigorous tests necessary to find out their precise qualities and strengths.

Most of the instruments in gliders are exactly the same as those used on light aeroplanes—air-speed indicator, altimeter, compass, and turn and slip for blind flying, as well as a variometer. It should be remembered that the air-speed indicator only gives the speed of the glider

through the air, and does not indicate the speed at which the glider is travelling over the ground.

The altimeter gives its information from the changes of atmospheric pressure with height. As you go higher the pressure of the air gets less and less, and this is shown by a needle on a dial. The face of the dial can be marked in feet, metres, fathoms or any unit of height or depth you want.

The important thing to remember about the altimeter is that it only shows you the height above the point of departure or sea-level, depending on how you set it. The altimeter does not tell you the clearance height you have over the hills and mountains that you may cross.

For instance, if you are flying from an aerodrome five hundred feet above sea-level, and you set your altimeter on the ground at five hundred feet, if you then went to the coast, and flew along above the sea with your altimeter reading five hundred feet, you would be approximately that height above the water. If you now flew back inland with your altimeter still saying five hundred feet, and you came to some hills six hundred feet high, their tops would be one hundred feet higher than you. If, therefore, you are flying in bad weather, it is very important to look at your map, and see that there are no hills or mountains on your way, which are even nearly as high as the height you intend to fly at on your altimeter.

If you are going to practise circuits from your aerodrome five hundred feet above sea-level, you may want to set your altimeter at zero, so that you can get some idea of your height above the ground for each approach. If you do this, and then get a thermal and fly to the coast, your altimeter will read zero when you are still five hundred feet above the sea. Or, when your altimeter

reads five hundred feet, you will actually be one thousand feet up.

Your altimeter is, of course, also affected by changing weather. If you are doing a long flight towards the worsening weather of a depression, the actual pressure of the air is getting lower towards the centre of the depression. As I told you earlier, the air pressure decreases with height, and the falling pressure on the capsule of the instrument gives you readings of increasing height. But the instrument cannot reason, and so if you fly towards a depression when the pressure is lowering, the altimeter will cheerfully give you a corresponding reading of increasing height.

If you are in radio contact with a Met. station you can get pressure corrections for your altimeter to reset it by. If you cannot do this, then, of course, whenever you are flying towards worsening weather you must regard your altimeter readings as suspiciously optimistic and give any hills plenty of clearance.

The variometer is the most useful instrument the glider pilot has, as it shows him when the glider is gaining or losing height.

In absolutely quiet air, it will show the actual sinking speed of the glider itself. If the indicator shows lift, the glider will be gaining height at the rate indicated, although the true speed of the up-current will be higher by the amount of the sinking speed of the glider.

The variometer also works on the principle of pressure change, but I will talk about it more when we come to use it.

CHAPTER SIX

STARTING TO FLY

In a few minutes' time you are going to begin your flying training. You have had one flight to get used to the idea of being in the air, but from now on we are going to try to do at least three consecutive flights.

Get into the same seat of the two-seater that you had before, and do up your harness. Do you remember? Good! Now, before every flight you must do your cockpit check.

Put your feet on the rudder pedals, hold the control stick in your right hand, and move the controls about to get used to them. This yellow knob on the instrument panel operates the cable release. You pull it hard, twice, at the end of each launch. This other handle forward between the seats opens the airbrakes.

Now you must check the controls. It is not likely that anything has gone wrong with them since the last pilot flew, but it is a good habit to get into, and very soon you will find that you do it automatically. You are trying to find out two things. Do the controls work in the right sense and direction, and are you getting full movement? It is easy for seat cushions and maps to get in the way of the controls, and once a cat climbed in when the pilot was at lunch and went to sleep behind the rudder pedals. The pilot forgot his control check and on take-off was scared out of his wits by the furiously angry cat.

When we are satisfied that the controls are all right,

we must check the trimmer. This is forward for nose down, and the tab on the elevator moves the opposite way to the movement of the primary controls. This is the airbrake lever, pull it to open the brakes and then ask the wing-tip holder if both brake surfaces on top of the wing are fully out. Close them again. Now we can hook on the cable. Pull the yellow knob when the man holding the cable shouts "Open," and let it go when he shouts "Close."

With the wings held level, and the cable hooked on, we are ready to start our first lesson. I am going to show you in the air the use and simple effect of the elevator and the ailerons, and then let you try them.

I will take the glider off, and climb it on the launch, but I want you to follow what I am doing. Keep your hands and feet lightly on the controls.

The signaller is looking at us to see if we are ready to go.

"Clear above and behind? Take up slack."

Now the winch cable has been pulled up tight.

"All Out."

To take off get the glider running along on its main wheel, neither trailing the tail skid on the ground, nor rubbing the nose skid. As we gather enough speed, the glider takes itself off and goes in to its initial climb. Keep the wings level, and the glider running straight.

Now we are in the air, and we must not let the glider climb steeply until we are at a safe height, and have enough speed.

About one hundred feet up I can begin to steepen the climb. Look out at the wings and notice their angle to the horizon. Our speed is just under fifty miles per hour and we are going up well.

Now we are near the top of the launch, and you will

notice that it is no longer possible to climb so steeply, as the pull of the winch cable on our nose is more directly downwards as we get nearly overhead.

I am going to put the nose down, so that the glider is in its normal flying attitude, and release the cable. Notice that I pull the knob twice to make quite sure.

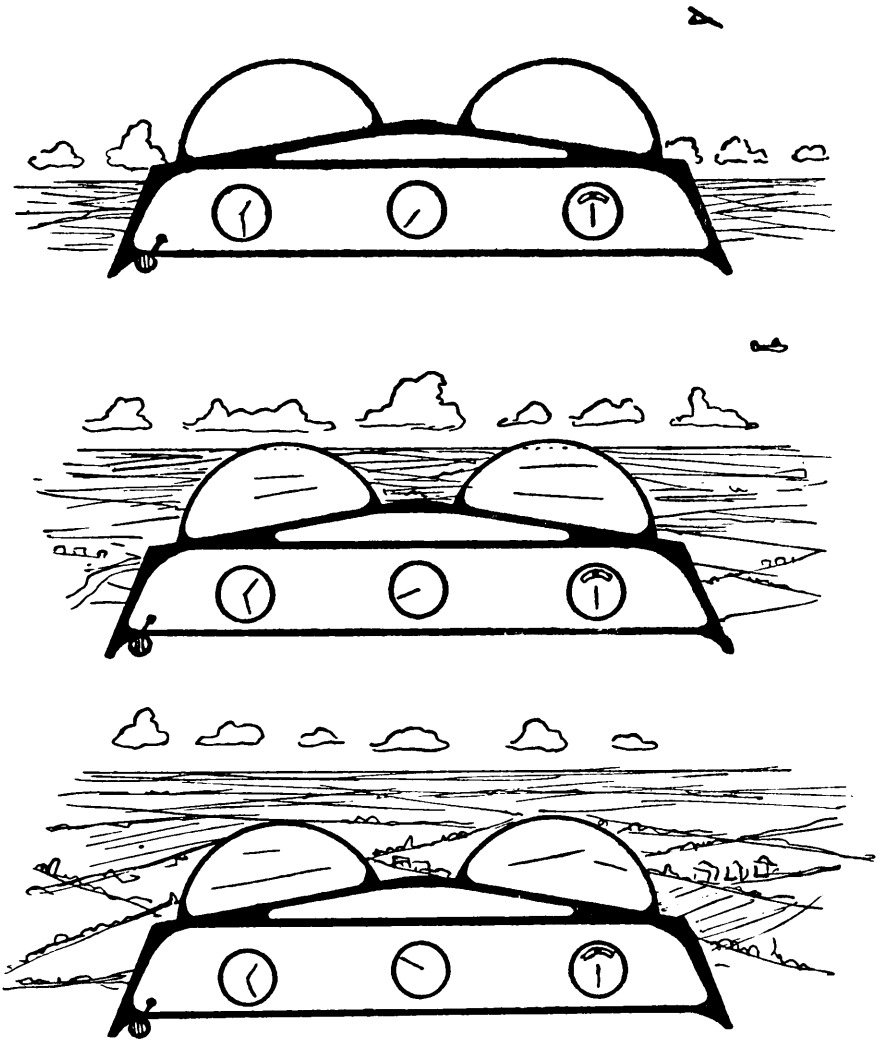
We are on our own now and flying at the right speed. Look ahead, and see where the top of your windscreen cuts the horizon, and try to remember the position because it is one of the easiest ways of keeping your speed correct. Notice the noise, this also helps you to check your flying speed, also the feel of the air on your face.

The air-speed indicator is showing 37 m.p.h., although I do not want you to judge your speed by this instrument, but by the feel of the glider. The A.S.I. should be used as a check only, because all instruments are liable to go wrong, and you want to be able to fly properly without them.

Now we will try the elevator control. If I move the stick forward the nose goes down. The speed increases and so does the noise, and the airflow on your face. You can see more ahead, and the top of your windscreen, which in normal flight is about on the horizon, is now below.

If I move the stick back, the nose comes up, and the glider goes slower. The noise gets less, and the air on your face begins to die away and the controls feel sloppy. The view ahead is hidden by the nose, which is now above the horizon. If we should continue to get slower, the glider will stall. So remember, when everything seems strangely quiet, and the glider is not answering crisply to the controls, you are flying too slowly. Get the nose down at once.

You try the elevators. Move the stick forward, gently. That's enough. Notice the position of your windscreens and the noise. Return to level flight. That's about the right speed. Now bring the nose up



Position of the nose on the horizon.
Top. Too slow. Nose high in the air.
Centre. Correct.
Bottom. Too fast. Diving down.

by bringing the stick back. That's enough, now return to our normal flying position, and see if you can memorise it. Slightly faster. Yes, that's it, a steady whistling noise, and the top of the windscreen cutting the horizon.

As well as moving fore and aft, the stick moves from side to side operating the ailerons which are the main turning control. If a wing goes down, the glider will start to turn. That is very important to remember.

When I move the stick gently to the left, the left wing goes down and then the glider will start to turn away to the left. Glance out at the wingtip. That is about as much bank as you will need to do gentle turns.

Return to straight flight, move the stick over to the right, the right wing goes down, and the glider then starts to turn away to the right. Back to straight flight again, and you try. Stick to the left, the glider banks to the left. Good. Stick to the right, and the glider banks to the right. Use the controls gently, and hold the stick lightly. We haven't got much height left on this circuit, but until we are low enough to go in to land, try to fly the glider straight and at the right speed. Do not move the controls so fiercely, only very gentle movements are needed. Put your left wing down—gently—and level her up again.

Now I will go in and do the landing. I am turning into wind now, and because we are a little high, I will open the brakes.

As we get close to the ground, we must start to check the glide, and then try to hold the glider off the ground until it is ready to land.

We have landed at the launching point so we can take off again from here, and this time, after we have released, I want you to practise using the elevator and aileron, and

keeping the glider at the right speed. Then I will show you the effect of the rudder. This is really an unimportant control for ordinary flying. The ailerons, as I said before, are the main turning control, the rudder only being used to help to make the turn tidier and smoother.

Here we are, then, at the top of the launch. You have the stick, and this is the right speed. Just settle down and fly straight ahead—good. Now put your left wing down—that is enough. Now level the wings again.

Try to fly straight towards that white factory over there, and watch your speed, you are getting too slow. You are still too slow. Get the nose down a little more. That is better. Now check that your wings are level. Good, you've noticed that you were flying right wing down, and you have corrected properly. Put your left wing down again, and now correct to level flight. Check your speed. Good.

All right, I have control now, and I am going to hold the glider level, and just use the rudder. If I push my left foot forward, the glider yaws or swings to the left, and if push my right foot it yaws to the right. You can feel that to turn by rudder alone would be an uncomfortable way of going round corners. You get a draught in your ear as the glider yaws and skids sideways, and you tend to slide outwards in your seat. You try the rudder, while I hold the stick. Left foot, yaw to the left, right foot yaw to the right.

Now take the stick as well, and try to fly the glider straight towards that wood to the north of the aerodrome. You will find that you need practically no rudder at all. Watch your speed, you are getting faster and faster. Keep checking the attitude of the glider and the whistling noise.

Your left wing is going down, bring it up—gently. All right, I have got her now, we will go in and land.

On our next circuit, I am going to introduce you to turns. You have probably noticed that every time you put a wing down, the glider turned in that direction, as I said it would, and that by telling you to lower a wing, and then fly straight again, we did in fact make our circuit of the aerodrome with you doing all the flying.

Now, I am going to give you a simple drill for doing turns, then show you one in the air, and then let you get on and practise until you can do them properly.

To do a turn: first of all look round to see if the air is clear of other aircraft. This is very important and you must do it properly.

Secondly, check your speed, and get it right.

Thirdly, put on as much bank as you think you will want and a little rudder in the same direction at the same time, to help you go smoothly into the turn. Maintain the turn by maintaining the same angle of bank. Use the bank as your datum, get it right, keep it constant, and then make your other corrections accordingly.

To recover, level the wings, using a little of the opposite rudder at the same time to help you come smoothly out of the turn.

Re-check your speed.

Can you remember that? Here comes our winch cable now. I will go through it again, when I show you a turn after releasing.

On this launch I want you to tell me when you think I ought to release at the top. Look out at the aerodrome during the climb. You will not be able to see the winch, but it is standing just on this side of the perimeter track.

Here we go, then. The speed of this launch is not

quite fast enough, so we cannot afford to climb very steeply, in case the cable breaks.

I will give the signal to go faster. I waggle my wings, and the winch-driver should speed up a bit. Yes, he has. Can you feel the glider wants to climb now, and not just mush along?

You say I should release now. It's a little early, we can gain another fifty feet or so. This is about it. Will you pull the release—twice—and then get her flying straight. She's all yours.

Is your speed right? Everything seems a little quiet! That's better. There is no sense in flying too slowly, always try to have enough margin in hand. Keep your hands and feet on the controls, and follow me round this turn.

First of all look right round. You want to be able to see the tailplane out of the corner of your eye.

Check your speed and put on bank—about this amount for ordinary turns, look out at your lower wingtip, and see by how much it cuts the horizon—and put on a little rudder in the same direction.

Maintain the turn by maintaining the bank. We are turning quite steadily, and smoothly, and you will see that the amount of bank does not vary.

To come out, level the wings, using a little rudder at the same time, and re-check your speed.

Now you try. A nice smooth left-hander, please. And don't forget to look round.

That is enough bank—now you have got too much bank on and the nose is starting to go down. Do not try to correct the position of the nose, until you have got the bank right. That's better—keep the bank like that. Return to level flight—wings level, opposite rudder. Now re-check that speed.

That was not too bad for a first attempt, so try a gentle turn to the right.

That is the right amount of bank—it is actually about thirty degrees—hold it, and make your turn accordingly. Move the controls quite gently—the glider flies very well by itself, you've only got to guide it.

Keep the bank constant and get the nose moving steadily round the horizon. Come out now, re-check your speed, and go into a left-hand turn, and see if you can fly steadily round a full 360 degrees.

Look round—good, that was all right. Your bank was steady, although your speed wandered a little, but now we must go in and land.

Turn towards the end of the main runway, and fly straight. We will land on the grass just to the right of it, so if you can keep her really straight, I shall not have to take over until just before the landing. Your right wing is down a little, and this will make the glider turn away to the right, so keep checking that your wings are quite level. That's fine, you were able to fly down to within fifty feet of the ground, although your speed was getting higher and higher. I have got her now, but keep your hands and feet on the controls, and feel how gradual and gentle the hold-off must be. Never move the controls violently. We are floating along just above the ground, waiting for the glider to sink on to it. Now we have touched on our wheel and tailskid, and must keep the glider straight until we come to rest.

Later we will have three more flights if possible, so I am going to tell you about the two faults that are easy to make in turns, and how to correct them.

The first is skidding out. If you are in a correctly banked turn and you put on too much rudder, the glider will skid outwards, much as a car will skid outwards

across a slippery road. You notice this, as I said, by the draught coming from the outside of the turn, and by tending to slide outwards in your seat. Correct by using less rudder.

If you have the right amount of bank on, but the glider is slipping inwards towards the middle of the turn, it is because you have insufficient rudder. You are side-slipping without really turning. Correct by using a little more rudder in the direction of the turn.

So remember, if when turning at your chosen angle of bank you are skidding outwards you have too much rudder, and if you are slipping in, and the draught is coming from the inside of the turn, you have too little rudder. Keep your bank constant, and correct slip and skid with rudder.

If you have got your speed right before you start turning, and you take care to apply the right amount of bank, then skidding out and slipping in are the only faults likely to occur in gentle or medium turns.

Steep turns, however, bring some problems of their own. I will tell you about steep turns now, although you will not do any in the air until you have done quite a bit more flying.

You have noticed that in the gentle turns we have been doing we have not needed a great deal of bank, but in a sharp turn the glider must be banked well over on to its side and the nose kept travelling steadily round the horizon by a backward pressure on the stick.

The most important thing to remember about steep turns is that the stalling speed increases, because the wings have not only to provide enough lift to support the weight of the glider, but to overcome the increasing load produced by centrifugal force as well. In ordinary turns we have been flying with sufficient margin of speed

to overcome the slight increase in stalling speed. But the steeper we turn the more rapidly does the stalling speed increase, so that if we managed to make the glider do an almost vertical turn, the stalling speed would be nearly double the normal stalling speed. In other words instead of being about 30 m.p.h. it would be approximately 60 m.p.h.

So when you are thinking it would be fun to try some steep turns, make sure you have enough speed in hand before you start, and if you find that the nose is dropping, and the speed increasing, reduce the angle of bank, and make the turn less steep.

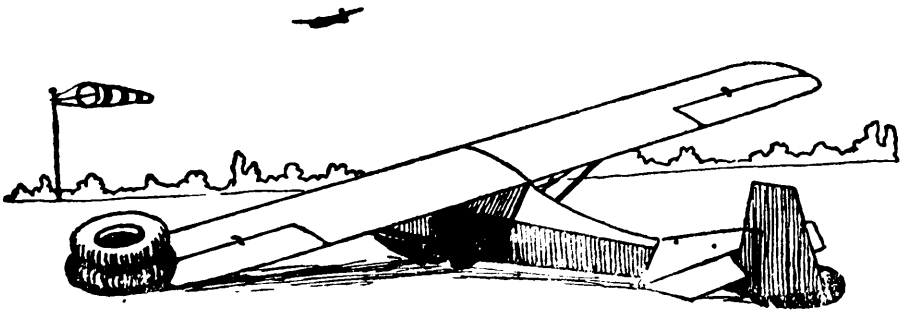
CHAPTER SEVEN

LEARNING WHAT NOT TO DO

It is fairly windy today so that we shall have to be careful not to let the glider get blown over on the ground. Never get out of the cockpit after landing until helpers have arrived, and then always keep some weight on the nose as long as the glider is facing into wind.

When you are turning the glider round, the windward, or into wind, wingtip should always be held, and when the glider is parked, one wingtip should point into the wind, and be firmly weighted down with old tyres or something suitable. Another tyre should be put against the lee side of the tail skid, to prevent the glider weather-cocking round nose into wind.

If you are towing the glider out to the launching place behind a car, you must not go faster than walking speed, and if you are driving into wind, you must have somebody in the cockpit, or at least weighting down the nose.



Parking a glider. Weights on into wind wing, and old tyre to the lee side of tail skid.

It is often easier when moving the glider by hand to pull it along backwards. One person on the wingtip, and two people carrying the tail saves the tail skid being worn out, and the tail being dragged sideways across bumpy ground as would happen if it were pulled along nose first.

But however you may be moving it, if the wind is strong, have somebody in the cockpit to hold the controls still, as, if a gust suddenly slams the control surfaces across, they may well get damaged.

Unlike little sailing boats, gliders are not designed to be blown over and they can be easily damaged by incompetent ground handling, and repairs are expensive and take a long time. If you see a glider carelessly parked, do not say, "Look how some stupid person has left that glider," go and *do* something about it, even if nobody thanks you afterwards.

On our flights today we will try to polish up your turns, which are getting much steadier, and we will do some stalls, and possibly an incipient spin or so. It is unfortunately too gusty near the ground for you to do the take-offs and landings, so they will have to wait for a while, but you can follow me as I do them.

Do up your straps and check the controls and brakes. Do not hook on the cable until we are both in the cockpit and ready to go.

You remember that when we were trying out the elevator, if we moved the stick back we flew slower? Well, if we continue to hold the nose up and fly slower and slower, the glider will stall, and fall nose down out of control until by falling it has gathered enough speed to go on flying once more.

This sounds alarming, but these gliders are really very kind and only stall gently, as well as giving you plenty

of warning. There is absolutely no excuse for stalling by mistake, but you must do some practice stalls high up, so that not only do you know what they feel like, and how to recover from them, but more important still, what the glider feels like before it stalls.

I will take off, and about half-way up the launch I will hand over to you. I want you just to keep the glider flying straight, and at the same angle of climb, and then tell me when you think we should release, but don't do so until we agree. It is gusty, and so we will tend to take off rather quickly, so I will have to hold her down a little to begin with. Here we go then, running along on the wheel, and almost at once we are airborne. Slowly we can start to climb. Now then, she's all yours, keep her as she goes.

Your left wing is going down, bring it up, otherwise we will not keep straight. Good, that is nice and steady. Look out and see if you think we are getting near the top of the launch. I expect you can feel the slight downward pull on the nose. You want to release now? Yes, we're just about there, so go ahead. Get the nose down first, and after releasing adjust the speed. Now turn gently to the left so that we get clear of the launching line.

I will show you a stall now, so keep your hands and feet on the controls. If I raise the nose above the horizon, the speed gets less and less, the air on your face and the noise die away, and you are left in an odd draughty silence. The controls feel almost useless, then the nose drops like this of its own accord, although I go on moving the stick back. This is the stall, but we soon gather speed again and can return to normal flight. You try a stall now, but try hard to keep her straight beforehand. You will find firm control movements are necessary, as

the controls are not very effective. Hold the nose up, and stop the glider falling away to one side. You can feel that it does not like being flown in this way. There she goes, the nose is down now, and we have quickly gathered speed, so correct to normal flight.

Now do another one for practice, and then turn and fly towards that same white factory again.

All right, I will take her in to land now. You will notice that I have come higher over the boundary of the field than we were yesterday. This is because the wind is very strong, and if we do not have plenty of height in hand, we may undershoot, and not be able to reach the landing area.

While we are waiting for our next launch, I will tell you about spins. Just now we were doing straight stalls, but if we stall in a turn or with rudder on, an aircraft will fall away sideways as it stalls, and start to spin round and round. Fortunately these gliders do not really like spinning, and do not do it at all well. This two-seater can sometimes be persuaded to go all the way round, but usually it turns about one hundred and eighty degrees, and then recovers.

Again, spins are perfectly safe to do high up, and are only dangerous if done very close to the ground. The way in which we will practise spins, is the sort of way in which inexperienced pilots can get into them by mistake, except that we will do them at a safe height.

There is no point in demonstrating spins to you as a sort of academic aerobatic manœuvre, you would not do such things without intending to, but you may well do the sort of thing I am going to describe, unless you realise the dangers.

You are coming in to land, probably on a windy day like today, and you suddenly realise that you are lower

than you meant to be, and it is doubtful whether you will clear the trees on the boundary, so without thinking you unconsciously fly the glider slower and slower, trying, almost by your own strength to hold it up in the air. Then as you get nearer, you realise you will have to turn to avoid the highest trees, and as you bank you are afraid that your lower wingtip will hit the trees, so you do not bank very much. You are now doing a low slow flat turn, and you have all the ingredients for a spin, with too little height to recover. If you ever do find yourself approaching such a position, get that nose down and build up speed, more and more speed. Then if necessary just lift the glider clear of the trees, and then get the nose down again. It never pays to fly slowly near the ground.

Well, if we get a good launch this time, we will do a spin, so that you will know what the glider feels like as it approaches.

To recover from a spin. As I said, these gliders come out of a spin more or less on their own, but you will not always be flying gliders, and therefore you must learn the proper recovery action, so that if you do ever need it, it comes out of your brain automatically without your having to start thinking about it then. The recovery action is, and you should learn it parrot-wise:

Full opposite rudder.

Slight pause.

Stick steadily forward until the spinning stops.

Most gliders will come out as soon as you put on opposite rudder, but you must learn and remember the proper recovery drill.

Here comes our cable now. Is your harness done up properly? Check your controls, then, and get hooked on.

I will take off, as this wind is still unpleasantly gusty near the ground, and you can take over about half-way up the launch again.

Notice that the wind is blowing slightly across our launching line now. This will mean that unless we correct for drift, we may well release our cable from such a position that it drops on the hangar roof. If you keep your windward wing slightly down, this will help to prevent you drifting.

Good. You managed that quite well. I can just see our winch cable with its parachute falling away beneath us now, and it is landing quite close to the runway.

How is your speed? Yes, you are quite right, we are much too slow. We do not want to spin before we intend to. It would quite spoil my demonstration!

Turn away from the launching line. Our height is a thousand feet and that is enough for what we want to do, so here we go then, flying too slowly, and doing a horrid flat turn. You can feel the sloppiness of the controls and the unnatural feel of the glider. If we go on flying like this we will spin. Like this. The glider has lurched over and is pointing straight at the earth as we start to spin round.

Full opposite rudder, and—— She's beaten us to it, and come out already. Correct to the proper attitude.

Spinning is a bit alarming at first, and although it is perfectly safe when done with plenty of height, it is a good thing to stay scared of flying too slowly near the ground.

We still have enough height for you to do one. I will help you go into the spin, and then you can do the recovery on your own.

Too slow—turn too flat. Difficulty in holding the

glider in this position, then down goes the nose and we are spinning. You correct, opposite rudder—good. Do not let the speed build up too much. That's about the right attitude. Now turn back towards the aerodrome.

Where is it? More or less behind us on the left. It is very easy to lose your bearings to begin with, and so it is always a good idea to notice your position in relation to the sun, or some prominent object, before you start spins, or until you get to know the surrounding country better.

We will do some more spins before you go solo, but we haven't enough height left now, so see if you can sort out an approach in to land, and I will then take over for the actual touchdown. Remember the wind is strong so do not get far behind the boundary hedge. Remember to look round before you turn.

As we get nearer the ground, it will get more gusty, but try to keep your speed steady. No, don't turn again just yet. Have you seen what is flying along on our right? It is the other two-seater, and if you turned now you would force him away from the aerodrome.

If you are wondering how he got there so suddenly, I can tell you that he has been quite close to us for some time, and in spite of reminding you to look out, you did not spot him. Fortunately he had seen us, and I have been watching him, but think of the possibilities if you had been flying alone, and he had not been looking out either. You must watch for other aircraft at all times, and, in addition, regard the pilots of all other aircraft as totally blind.

He is coming in on our right, so I will turn and land to the left of the runway to give him as much room as possible. It may be a pupil landing and we do not want to put him off.

You know, a very large part of flying is thinking about what you are going to do, and planning, and observing. A much smaller part is the actual handling.

At the moment I am planning the circuit for you so that we arrive back on the final approach with enough height to land, but soon you will have to do it for yourself. In the meantime every spare moment you have can be used to add to your flying knowledge, to help to make you a better pilot.

For instance, before every take-off, and during every approach, you should make a habit of looking at the windsock, and noticing whether the wind is changing direction or strength. It is possible for the wind to swing right round while you are in the air on a simple circuit, and you would look very silly if you landed downwind just because you had not noticed the change.

Try to teach yourself to watch the weather upwind. to see what is coming your way. If part of the sky is looking very black, it will obviously not affect you if it is already downwind, but if it is upwind of you, it will sooner or later arrive and may bring with it heavy rain or gusty winds. While you are still under instruction your instructor will not let you be launcehd at the onset of a storm, but once you start soaring on your own the habit of watching the weather upwind may help you a great deal. A storm can temporarily blot out your landing field, and if you have been circling up in a thermal, and you leave your return too late, the storm may beat you to it.

Sometimes storms will grow and spread, so that even if they look as though they are going to pass to one side, they may pour heavy rain all over you as they get bigger.

I have stressed the importance of looking round before going into a turn, so that you do not run into anyone

else, and you must also look round, of course, before spinning or doing any aerobatics, and before take off and landing. You should watch how many other gliders are flying from the same field, and where they are, although it is always possible for another glider to arrive from somewhere else and upset your calculations, but if you know that there are four other gliders doing circuits on a non-soaring day, and you can see only three of them on the ground, then you must assume that the other is in the air with you, and must make every effort to spot it.

Aeroplanes can usually be heard from a glider, but there is no excuse for not looking out for them. When you can actually hear an aeroplane, it is quite close, and aeroplanes can go pretty fast these days.

Flying gliders is much safer than a great many other sports, and if you find pilots telling you of all the narrow escapes they have had, you can be quite sure that they are not very good or sensible pilots. If you study any of these pilots who seem to live from emergency to emergency, you will find that they fail to make the most elementary preparations before they start. Then when something goes wrong they are unable to deal with the situation and the result is another lurid story to bore their friends with.

You will find that the really observant and competent pilot never seems to have to cope with any emergencies. This does not mean that his flying is dull and uninteresting; he certainly achieves more and gets more real fun out of his flying than the pilot who breaks his glider at the beginning of a flight and is only left with his monotonous tale to tell.

It is true that any sort of flying is inherently more risky than many sports that take place on the ground, because once you are up you have got to get down again.

But, in reality, this only means that in an aircraft you cannot be quite so irresponsible as you can in other things and still get away with it.

If you go out in a little boat without adequate preparations, you may well get drowned, but there is always the hope that someone else will come along and rescue you. It is the same on mountains. People climb mountains without the necessary skill, other people rescue them, and all is well. But in the air, if you make a mess of your flight, you have got to get yourself out of trouble, as no one can come and help you until you are back on the ground again. But why should they have to? It is an extremely selfish outlook to hope that someone else will risk his own life saving yours, when a little common sense would make the rescue unnecessary.

More people each year are killed on Snowdon alone than are killed gliding in the whole of the U.K. and this club here, touch wood, has now done forty thousand flights without anyone being injured.

Have you read the flying regulations in the clubhouse? You will find that there are not many, but you should learn them and always obey them. Each one exists to prevent the recurrence of a lesson learnt the hard way by the pioneers who started gliding in England.

I can teach you how to handle a glider, tell you what difficulties it is possible to get into and how either to avoid them or get out of them. I can tell you to look out for other aircraft, and later, how to land safely in fields. But I cannot train you to be observant, to plan your future flights, and to fly in such a manner that you neither hazard yourself nor others. That is up to you.

CHAPTER EIGHT

CIRCUITS AND LANDINGS

ON this circuit I want you to do the whole of the launch yourself, hook on the cable, take off, climb and release. You have had your hands and feet on the controls while I have been doing the take-offs, so you have an idea what it feels like, but do not forget to use the controls as coarsely as you need to keep the glider straight until it is going fast enough to take off.

Look ahead through your own windscreen and try to keep straight towards the winch. Be quick picking up a wing that goes down, otherwise you will soon swing away to one side.

Get the glider running along on its main wheel—it will take itself off. Do not let the climbing attitude get at all steep until you have plenty of speed and are at a safe height. If the glider starts "bucking" or "hunting" during the launch, ease the nose down slightly, as it means you are trying to climb too steeply.

Here comes the cable now, so I will leave it all to you. Tell the signaller when you are ready to be launched, but do not forget your cockpit check first.

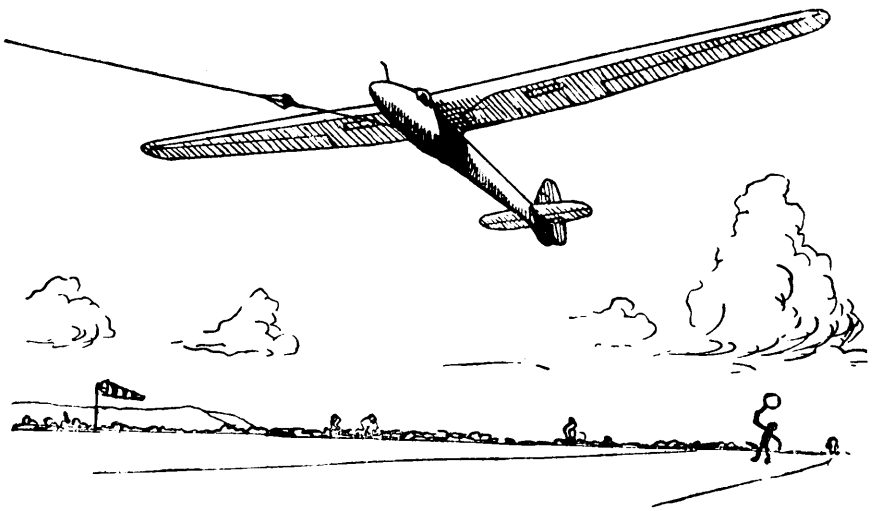
"All Out."

Your left wing is a little bit down and we are starting to turn. Good—full use of the aileron brought it up all right, but now we are airborne, so you must only use the controls very gently. Do not climb so steeply. If the cable should break at this moment, we might stall before we could get the nose down again. You are still too steep, lower the

nose. That's better, watch your left wing, it is down again.

Do not hold the stick so stiffly, a thumb and two fingers is enough, otherwise all your control movements are harsh.

Now we are at a safe height to start climbing more steeply, bring the nose up a little, and then look out at the wings to get a picture of their angle to the horizon.



Sky glider climbing on a winch launch.

We are about four hundred feet up now. Try to remember what this height looks like, because it is about the lowest height at which you can reasonably make a circuit of the aerodrome until you have a lot more experience.

Good, you are getting the nose down before releasing. Now pull the yellow knob twice.

Well, that was not a bad attempt, so practise some left-hand continuous turns, then we will fly on to our down-wind leg, and we will see if you can go straight towards the white factory, which shows up well today in the sunshine.

All clear behind, start your turns now. You are flying a little too slowly; get your speed right, before you put

on bank. Go round a full circle as steadily as you can. There is a draught coming in from the outside of the turn, can you feel it? Make the proper corrections. Quite right, we were skidding out, and so you took off some rudder and the skidding stopped.

Now straighten up, make for the white factory, and then I will land. Feel it carefully with me, as I shall want you to try the next one yourself.

While we are waiting for our next cable, I will tell you some more about launching.

Sometimes the winch may be driven too fast or too slow; in both cases the safest action is to lower the nose slightly. If you are too fast, this will reduce the load on the glider, and if you are too slow it will avoid any risk of stalling.

There are two signals which you should know and which you can use to tell the driver whether his speed is wrong. Perhaps you remember them, as I have mentioned them before? If you are going too fast, yaw the glider with rudder from side to side. If you are going too slow waggle your wings.

Occasionally the winch may fail, or the cable break, and you will have some practice at this later, but remember that if anything goes wrong at the start of the launch release the cable at once. It is better to waste a few minutes pulling out the cable again than repairing a damaged glider. For instance, if the winch cable is snatched up tight with a great jerk and then goes slack so that you run forward over the end of it, release at once; or if you think the tail of the glider has hit someone who has stupidly got in the way, then again release.

Here comes our cable again, and this time you are going to do all the take-off and climb, the flying and the approach and landing, but I will tell you when to turn in on the approach.

Cockpit check, look at the windsock, hook on and it's all yours. Good. You released at the proper time, although you did not climb quite steeply enough, and we have only got seven hundred feet, but it is quite enough for what we want.

Turn downwind now, and keep well out over the boundary of the aerodrome, otherwise you will be too close in to make a smooth gentle turn on to the approach. Your last turn not only needs to be done at a safe height—two hundred feet, if possible, to give you time to sort out the landing, but should be quite gentle so that you can help judge your approach by opening it out a little, or making it tighter. Glider flying must be done gently and smoothly and not in a rough, abrupt or hurried manner.

Now turn into wind, and get straight as soon as possible, pointing the glider towards that hangar or some other landmark on the far side of the aerodrome to help you keep straight.

Check that your wings are level and that your speed is right. Look well ahead, and as you get near the ground, very gently and gradually check your glide until we are floating along just above the ground.

Your right wing is down, and we are turning away towards that other glider which landed before us. Get your wings level, and *make* the glider fly straight towards that far hangar. That's better, start checking your glide now.

Hold the controls lightly, and be as gentle as possible. Go on trying to keep the glider off the ground by easing the stick very gradually back. We are floating along just over the ground, so wait for it. Do nothing. Now we have touched down. Keep straight and keep the wings level until we stop. That was not at all bad for a first attempt, but you must remember to hold the controls lightly. You are trying to develop flying ability, not a strong right arm.

We must push the glider back to the launching point, so hold the wingtip and I will lift the tail round. There is very little wind today, so two of us can manage to push it for a little way until the others arrive, then we can talk again about landings, because on our next flight I want you to try a landing with a lot less talking from me.

When you are coming in to land, and getting nearer the ground, your eyes are apt to get attracted by details of the surface, such as tufts of grass as they become visible once more, and you unconsciously stop looking ahead properly. Sometimes this also makes you fly faster and faster as you near the ground. So make yourself look well ahead, about forty yards at least, during the final approach and landing, and keep checking your speed on the approach.

When you are landing, there are two faults which are very easy to make. The first is to start checking the glide and so reduce speed too high, with the result that the glider starts sinking rather fast on an even keel. The glider is near the stall, but not actually stalled, so that the nose does not drop. If you feel the glider sinking, or "parachuting" on the final approach, it means that you are holding off too high, and you must obviously increase the speed again, but do it gently, as gliders do not like rough control movements near the stall.

The other fault, of course, is not starting to hold off until too late, so that the glider strikes the ground in nearly the normal flying attitude.

This is equally hard on the glider and the instructor's nerves, so always take as much trouble and care as you can with your landings; and remember a good landing is the result of a good approach. If you are still coming out of your final turn, looking at the windsock, and trying to sort out your speed, when you ought to be straight into wind ruminating quietly about how you are going to land

and nothing else, it is not surprising that the wretched glider is bounced across the field.

It is perfectly possible for gliders to be landed across quite strong winds, but until you have more experience, always try to land exactly into wind. Sometimes, owing to obstructions on the landing area, this may not be possible, so get as nearly into wind as possible, and come in to land with your into-wind wing slightly down, as I told you to do for out-of-wind take-offs. This will make you slip into wind slightly and help counteract the drift.

If the drift is considerable, there is another method of overcoming it, but you should not attempt it until you know that you can land properly without bouncing.

Come in trying to cancel the drift with the into-wind wing slightly down, and by looking at the ground ahead see how bad the drift still is. If the ground still appears to be travelling from, say, right to left across your nose, you still have on considerable drift to the right, even though your left wing is slightly down. You obviously cannot go on putting your left wing down as it is not high off the ground anyway, and if you start actually turning rather flatly to the left, you will find you even add to your drift over the ground. What are you going to do?

Immediately before touchdown you yaw the glider to the right with right rudder, in the same direction as you are drifting. This has the effect of letting the landing-wheel or skid touch the ground going in much the same direction as the whole glider is drifting, with consequent reduction in sideways load on the wheel. This works as long as the glider is kept firmly on the ground after touching, but if it is allowed to bounce, your cunning little manœuvre is entirely wasted. The drift is now worse than it was, as the whole glider is airborne again even more out of wind than before. But if you want to avoid all these compli-

cations, then take that extra bit of trouble to get straight into wind in the first place.

Tonight there is no wind, so you can just practise circuits and landings with little to worry you, except that we may have to push the glider back a bit more, as there is no wind to help shorten our landing run. However we will start doing landings using the airbrakes.

The brakes, as you know, spoil some of the smooth airflow over the wing. Therefore to maintain the same speed the nose must be put appreciably further down. This means that the glide path is much steeper, and it is therefore easier to land in a small field surrounded by high trees from an easy straight approach than it would be without brakes.

On our next circuit I shall tell you to turn in higher than usual, then I want you to open your brakes, and hold them steady until you are about fifteen feet off the ground, then half shut them and keep your hand on the lever, until you have landed. You will find that even half brake during the landing will cut down the hold-off time and the landing run. Come in with a little extra speed when using brakes.

Here we are, then, on the approach turning into wind. Now open the brakes. You will notice that your view ahead is better as the nose is further down. Brakes halfway in now, and hold them steady. If you suddenly open them just before landing the glider will drop heavily on to the ground.

Good; try to hold her off the ground as long as possible. The glider does the landing, not you. If you just shove it on to the ground, the arrival not only looks untidy but wears out the glider. Keep straight, and hold her off. Hold off. That's better. She touched down on the main wheel and tailskid together in a very nice landing.

On our next circuit I want you to open the brakes when

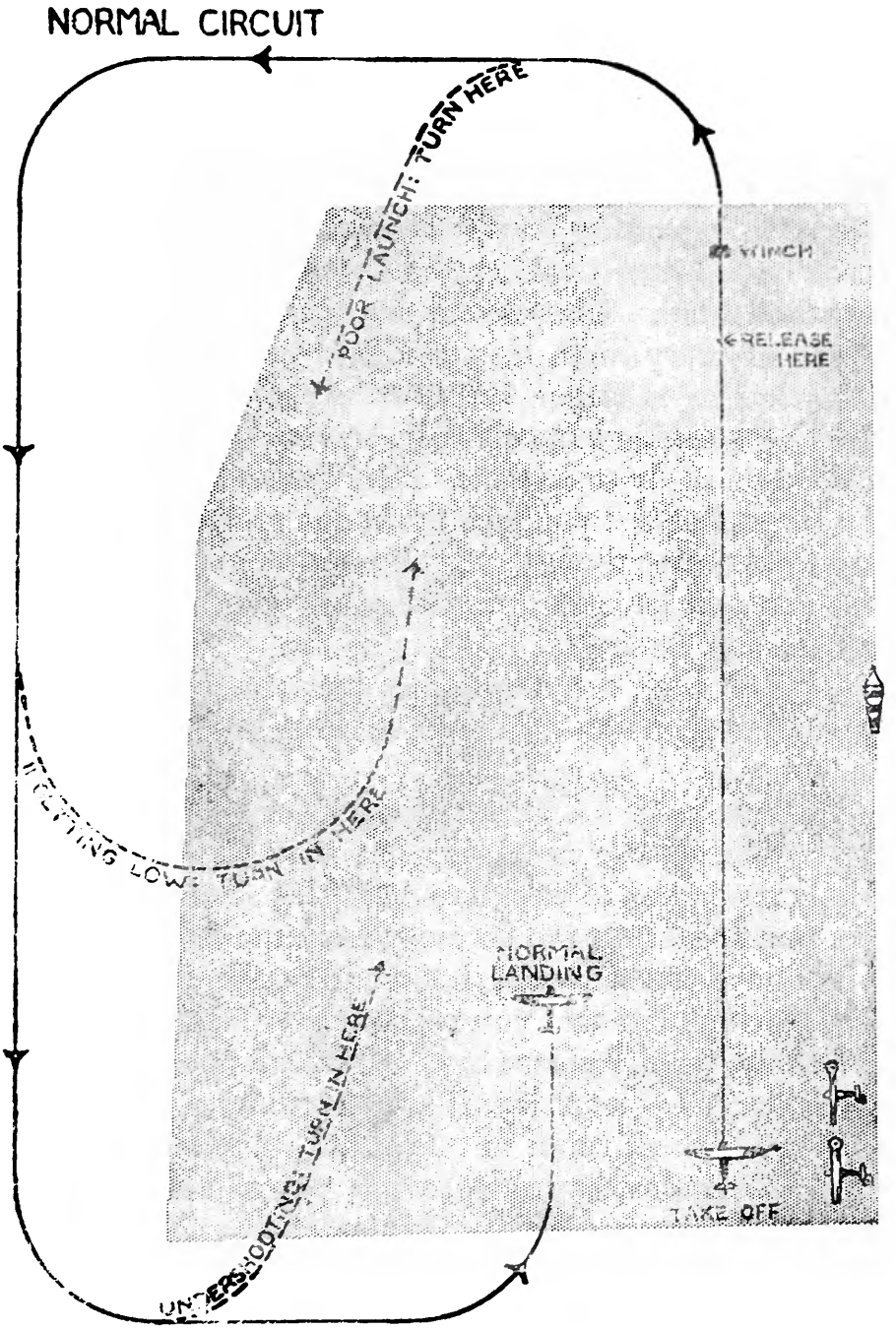
you think it is time, but this time do not necessarily hold the brakes steady during the early part of the approach. Vary them to control your rate of descent as you need. If you think you are coming down too quickly and you may under shoot, close them either partially or completely. If, on the other hand, you think you are higher than you want to be, then open them more, or hold them hard open.

If your approach is nice and steady, keep the brakes open for the landing, but remember that you must not get slow before you start to flatten out and hold off. If, however, you find that the landing is getting in a bit of a muddle, close the brakes, as this will let you float further, and have more time to think about what you are doing. But whatever you do, do not start opening and closing the brakes suddenly during the landing, or you will confuse yourself and probably land heavily.

So far, on all our circuits, I have told you where to turn into land, and it is about time you started planning this yourself.

Try to think of your whole circuit as a square. On the first side of the square do your launch and at its end release the cable. Then turn through 90 degrees on to the cross wind leg and say to yourself, "Have I had a good launch or not? What sort of circuit can I do?" If you have had a bad launch, then turn on to the downwind leg, or the side of the square parallel to your launch line, as soon as possible, but if you have had a good launch, carry on crosswind planning to make quite a big square, and then turn on to your downwind leg, the third side of the square. On this leg you must keep looking at the landing-place and saying to yourself, "Am I high, or am I low?" If you are high then edge out a bit further from the aerodrome. If low, come in a bit closer.

Then if it is a normal sort of circuit and you have enough



Planning the circuit.

height in hand, turn 90 degrees again on to your final crosswind leg just behind the boundary of the aerodrome, or above it if the wind is very strong. On this fourth or final leg consider again, "Am I high or am I low?" If you are low, turn into wind on to your final approach at once. If, however, you have enough height, carry on across wind until opposite the launching line, and then turn into wind. Use your brakes as you need, and land. If you are very high, then use your brakes on the final crosswind leg as well.

Let's go and do a circuit now, and see how you get on.

Are you ready to launch? Dive brakes in and locked? It is important that you lock the brakes properly, as if they come out during the launch, you may not get much height and you will have to do some pretty quick thinking to make a safe landing.

Climb her up, then—and keep level; you are still a bit inclined to go up on the launch as though you are lame in one wing.

Now the cable has gone, what sort of launch have you had? Yes, you're right, it's not very high, so you're wisely turning on to your downwind leg almost at once, so that you do not get too far away from the field.

But now you are overdoing it and getting in so close to the launching line that you will not have air room to turn round into wind, let alone have even the shortest final crosswind leg. If you are low it is better to keep out a bit so that you have air room to turn, and then make your turn early during downwind leg, while you still have enough height left to turn safely. This may mean that you will turn while still over the aerodrome and probably end your landing run somewhere up by the winch. But that is unimportant compared with making a safe approach and landing.

That is better now, you have moved outwards a bit, and are not so badly off for height as you thought. We are now over the rear boundary and you are sensibly turning a little early on to the final crosswind leg so that you have a safe margin of height. Turn smoothly round into wind, and you have enough height to use your brakes a little. Good, you have sensibly closed them as we are a bit low over the perimeter track.

The landing was a bit rough, but it was not a bad circuit really, and from now on you shall do all the planning yourself. But please remember, I do not like being landed on the tree tops.

CHAPTER NINE

AUTO-TOWING AND FIRST SOLO

So far you have only been launched by winch, but today we are going to do some auto-towing. It is really very similar to winch-launching, and quite easy to do provided you remember one or two minor differences.

First of all you get a smoother launch altogether, and you need not climb quite as steeply to get the same height as on a winch launch.

Piano wire is used instead of steel cable, and is perhaps slightly easier to break if you pull up abruptly or too steeply, so go easy on the launch.

The finish of the launch is easy to judge, as there comes a time when the car cannot go any further without running through the boundary hedge, and it has to stop. And when the car stops so does the launch, so get the nose down in the usual way and release.

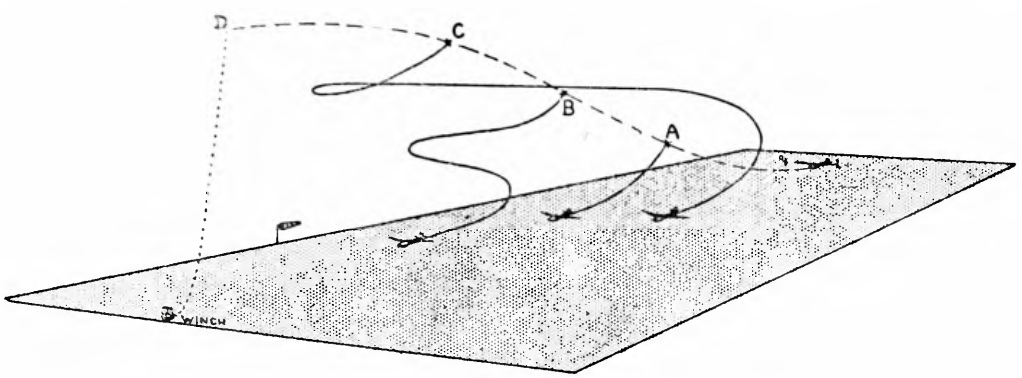
There is something else new to show you today as well. By some strange luck you have not yet had any cable breaks or launch failures, and so we are going to practice some deliberate ones. After you have done one or two auto-tows, I will tell the car driver to stop the launch at any moment he pleases, so that the "breaks" will be quite realistic. Like spinning recovery it is best to remember a drill for cable breaks, because they happen suddenly, and you do not want to have to start thinking what to do when you are sitting half stalled at a height of fifty feet.

So, if the cable breaks, or for any reason the launch fails, first of all *get the nose down*, and I mean well down.

If you are in a steep climbing position you will be surprised how far you have to get it down in order to keep enough speed.

Release the cable. You may not have more than an inch or two of it left on your hook, or you may have several hundred feet. You cannot see, so release to make sure.

Think: is it it possible to land straight ahead? But do not mess about with the airbrakes until you have decided what you are going to do.



Cable breaks:

A. If cable breaks low down land straight ahead.
B. If too high to land straight ahead, make an S turn.
C. High enough for a quick circuit.
D. Normal release point.

If you are too high to land straight ahead, think if it will be possible to do and S turn to use up the spare height and then go in straight ahead.

If this looks impossible, think if you have enough height to do a circuit safely, but do not attempt a circuit if you can possibly avoid it.

If you decide to do an S turn you should make the first part of the turn towards the side of the aerodrome nearest

you, so that you will have the whole area of the landing-ground before you when you turn back again. Another consideration is that of wind direction. If the wind is blowing slightly across the launching line, it will pay to turn away in a downwind direction first, and then when you turn back again you will be more nearly into wind.

Incidentally, if you ever have the choice of direction for an ordinary circuit, and there is a slight crosswind, it will pay you to turn downwind off the launch, so that you have less than three hundred and sixty degrees to turn in order to get round into wind again. If you turn the other way, you will have more than 360 degrees to turn to get into wind, and then if you get a poor launch or have a cable break it may be impossible to get round into wind at all.

Here is the tow car bringing our wire again now, and as soon as he has driven back up to the other end of it again we can go and try out our cable break technique.

Ready to take off, and remember: nose down, then release. We are high enough now to start climbing a little more steeply. Here you are, then, the launch has stopped. What are you going to do?

Good, you have got the nose down well, and you are quite right, we haven't enough height to turn, so you must go more or less straight ahead. But isn't there something you've forgotten? Yes, pull the cable release hard, and then settle down to make a good landing—this part of the flight is no different from usual. Alter direction very slightly to give the winches a wide berth just in case you get that far.

Well, that has made a start on the art of dealing with cable breaks. We will push the glider back, and do another one.

This time the car driver has stopped the launch much

higher up. You have got the nose down and released, and now what are you going to do? We cannot possibly get into the field by going straight ahead, and so we must turn. Quick, which way?

To the right? Yes, then when we turn back again we will have that long grassy run ahead of us.

Now you have turned back and more or less into wind again. Use your brakes as you need them, and keep your right wing down to counteract the drift you will get through being out of wind.

I expect you will get some genuine cable breaks before very long, but the glider should always be flown in such a manner that if the cable does break, it can be landed safely. In the meantime we will do some ordinary circuits to brush up your flying. If we get some high launches you can show me a spin and recovery, and if we get some low launches you can show me how you would manage a quick circuit and a landing well up the field.

Let's see, now, you have done thirty-one circuits and your turns are quite reasonable; if you start skidding or slipping you manage to correct it fairly quickly. You can fly at a steady speed, and you remember to increase speed for the approach. You have stopped gripping the stick as though it were a sledge-hammer, although you should still try to hold it more lightly. You remember to look out on turns, but you can still improve your ability to *see* when looking. Your take-offs and landings are all right, but do not start climbing steeply on the launch before you are at a safe height. You have also done some stalls, spins and cable breaks.

Well, there is not much use my wasting time sitting here. You can do this circuit on your own, with a can of ballast beside you instead of me. I will strap it in straight away and you can go off on the next launch.

All right, then, do exactly the same sort of circuit that you have just done with me, but remember that the ballast is not quite as heavy as I am, so the glider may feel a bit more buoyant. Now, off you go.

I know that you felt a little bit nervous before you took off, as I saw you swallow once or twice while waiting for the cable to come up tight. But nearly everyone feels nervous just before their first solo, and I didn't worry about you, because I knew that this nervousness would vanish as soon as you started moving.

You took off well, although during the climb your left wing got a bit low, and you drifted sideways, but you corrected that before the top, and released correctly. After releasing I expect you looked towards my seat, half expecting to see me there, and then felt excited for a second or so when you really realised you were alone at last.

Your circuit was very well planned indeed, probably because you were thoroughly scared of making a mess of it. If so, just go on being scared, it produces excellent results.

Your approach was made at a sensible height, but you let the speed get rather too high, and so in spite of the airbrakes you floated quite a long way. But that is a better fault than landing short. After landing you forgot the rule about staying in the glider until helpers arrived, and jumped out; however you remembered before we reached you and jumped back in again, so I won't hold that against you.

Anyway, it was a good flight, so you had better go and do another one to prove it was not a fluke. If you get a good launch see if you can spot the Solent and the Isle of Wight. It should be quite clear today. Then come round on a nice square circuit, and try to land where you did last time.

You will have to do three circuits for your B Certificate, one of which should be to the right, so as to show that you can make sensible turns and circuits both ways. When you have completed your "B" you will be entitled to wear the little blue badge with two white gulls, which is the first real qualification of the glider pilot, provided, of course, all your flights end with good landings!

"B" Certificate badge.

Before you fly solo again tomorrow, you will have to have a check flight in the two-seater, so put your name down on the two-seater flying list as soon as you get here; then if your flying is all right, you can go and do two or three more circuits solo in the two-seater, and then I might let you fly the Prefect single-seater.

I think you will like flying the single-seater very much; it is lighter and quicker on the controls than the big two-seater trainer, although the soaring performance is much the same.

While you are waiting, you might as well sit in this Prefect and familiarise yourself with the controls and the seating position.

You know that the release hook on the two-seater was centrally placed just under the nose? The hook of the Prefect is placed further back and slightly to one side, as it cannot be placed centrally because of the landing skid position. Being to one side does not matter, but the

further aft the position of the release, the steeper the glider will want to climb on the launch.

In the two-seater you had to keep some backward pressure on the stick to climb steeply, but with the release point a little further back, you may find that you even have to have slight forward pressure on the stick, particularly in the early stages of the launch, in order not to go up at too steep an angle.

Stay in the glider for a minute with the cockpit cover on. It sits on the ground much as it sits in the air at ordinary flying speed. Try to remember the view you get over the nose, then look out at the wing, and you will notice that the under-surface is parallel to the ground and the horizon. This is a good check for speed in a strange glider. If the under-surface of the wing is nose up to the horizon, you are too slow.

Now I will hold the tail down on the ground. This is the attitude you want to get the glider in for landing. Try to remember how the nose looks against the horizon. Just before you take off, I will show you these two attitudes again so that you will remember them.

This glider also has a trimmer, which you can adjust according to whether you are a heavy or light pilot. Without a trimmer the heavy pilot might be always pulling back on the stick to maintain the same speed as a light pilot pushing forward on the stick. As having to push or pull during a long flight would be tiring, a trimmer is fitted on most soaring gliders so that you can adjust it to take the load off the stick for the speed you want to fly.

To begin with, keep the trimmer central, and then when you are more used to the glider try trimming it in flight so that the speed will stay the same if you take your hand off the stick.

The airbrakes on this glider are more powerful than

on the two-seater, so for your first landing or so do not land with them more than half out, in order to give yourself more time to judge the hold-off and landing properly.

The Prefect is capable of being soared, of doing aerobatics, and of being flown cross-country. It is easy to fly, but takes hard work and skill to get the best out of its performance.

In the next few months it will be up to you, alone in this glider, to improve your own flying, and show what you can do.

CHAPTER TEN

STARTING TO SOAR

I HAVE been watching you doing circuits this morning and looking around for lift to keep you up. You are wanting to soar, and fly with those Olympias just underneath the clouds. You see them have a winch launch or an auto-tow and soon start circling, and while you glide steadily back to earth they stay up in the sunshine.

You do some circles, but it does not really make much difference. Perhaps you keep your height for a moment or so, but then you lose it and come down. So I am going to tell you something about how to find thermals, and having found them how to stay in them.

I have described to you how the thermal bubble forms just above the ground, and after breaking away slowly rises, drifting along on the wind until it becomes visible in the form of a cumulus cloud. If you are high enough, then obviously you want to make for a young growing cumulus, and the lower you are below it the more upwind of it you will need to be. If you cannot see any cumulus on a nice sunny day, or you are too low to use the clouds as guides, then you must rely on finding a thermal from consideration of the ground, and it is very difficult to find out when and where thermals will appear.

They do, however, pop up fairly frequently on good days, and sooner or later while you are doing ordinary circuits you will run into one, and you will want to be able to use it properly straight away. So, first of all, how can you recognise it?

As you fly along, you may find that the air has become rather rough and disturbed, but somehow not in quite the same way as it does in strong winds near the ground; or, without any warning at all, you may suddenly see the green ball of your variometer showing about five feet per second rise.

If the air is just disturbed, and the variometer balls are showing nothing conclusive, then you are probably on the edge of the thermal, but you do not know whether it lies ahead of you or to one side. So fly on quite steadily, trying to find out where it is. Look for birds circling nearby, and watch the variometer. Obviously if the green ball starts showing lift, then it is more or less ahead. On the other hand, if a wingtip feels as if it is being pushed up, then the lift is probably on that side, and it is worth turning in that direction, carefully watching the variometer.

If and when the green ball shows any steady rise, do not start circling at once or you may well turn back right out of the thermal again. Wait while you count three slowly, and then start to circle in a steady turn, taking about twenty seconds to go round. The thermal will try to tip you out of it, so turn towards the wingtip that tends to get pushed up, as I said earlier. If you simply do not know which way to turn, then go in the direction in which you can make the best turn, and do one or two circles. It is important not to dodge about and keep changing your mind or direction as you will probably lose the thermal altogether.

During these preliminary circles, watch the variometer and notice whether you are getting lift on some of the circle, and sink on the rest, or whether you are getting lift all the way round. If this last, and the green ball is steady, then just go on circling as evenly as you can,

keeping your speed the same, and turning accurately without any slip or skid, and you will go up.

If you are getting both lift and sink in the same circle, then note in which direction you are pointing when you are getting the highest rate of climb, and when you are getting the worst sink.

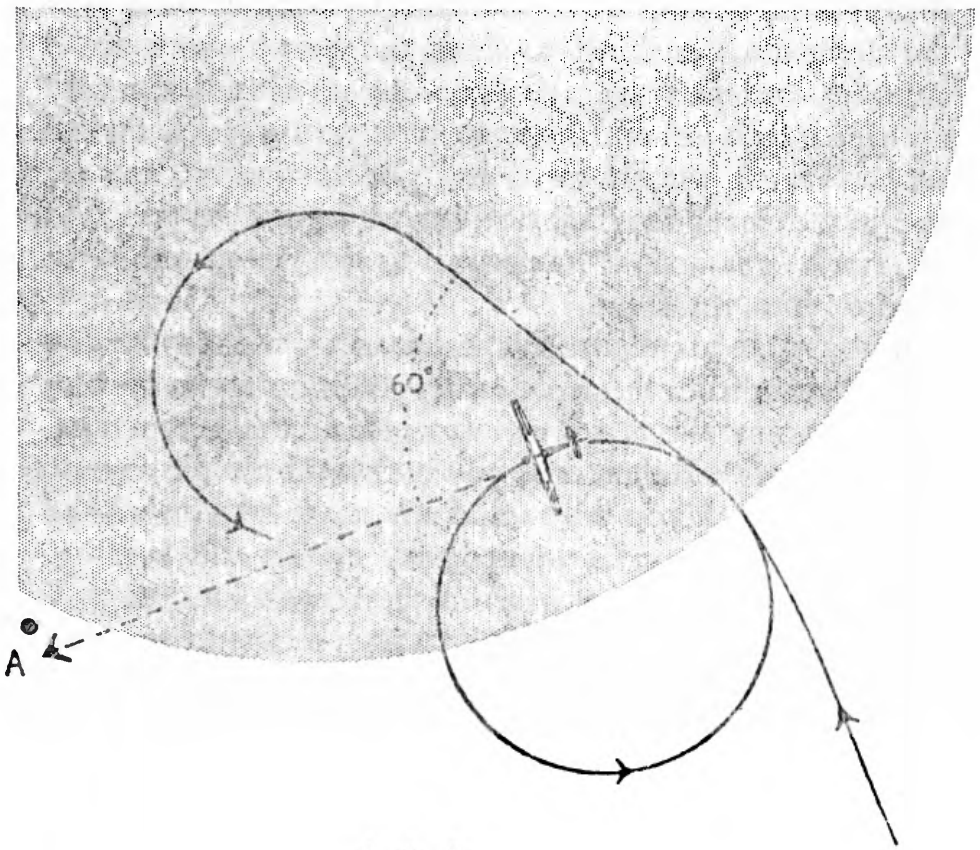
The variometer does not show you lift at the instant that the glider gets into it, as air has to pass along tubes and through the instrument to give you a reading, and this takes time. This lag in the variometer is several seconds. Therefore, if you are doing a right-hand turn and are pointing say due North when the variometer shows maximum lift, you should reckon that the true best lift occurred when you were actually pointing approximately to the W.N.W. about 60 degrees of the circle short of where the variometer said the best lift was. So, as you swing round on the next circle straighten up pointing about 60 degrees short of the direction in which the variometer showed maximum lift on the previous circle. It is not, of course, necessary to go on compass points. Any prominent landmark which coincides with the direction in which you get maximum lift will do.

Having straightened up, watch your variometer, and if it shows increasing lift, count three, and start steadily circling again in the same direction. Try this for a circle or so, and if necessary repeat the process. Until you have quite a lot of experience in hunting thermals, do not change your direction of circling, unless you have completely lost hope of finding it by any other means.

If you are half in the thermal and you change your direction of circling you will probably fly straight out of it. If, however, it appears to have vanished completely,

there is always a chance that you may, by luck, fly into it, or even another one, if you start circling the other way.

If you do get up in your thermal, the next consideration



One method of centring in a thermal.

A. Direction in which variometer shewed best lift.

until you have enough flying experience to embark on cross-country flights, is to see that you do not get blown or drifted so far downwind that you cannot get back to the aerodrome.

If you think that this is likely to happen, you must

leave the thermal and fly straight back towards the aerodrome, and if the wind is strong fly faster than usual, about 50 m.p.h.

If it is a strong thermal, or the wind is light, you will be able to circle in the thermal either to cloud base, or until the lift starts getting weak, and then fly back upwind over the aerodrome making towards the best-looking small cumulus you can see. If there are no clouds then fly straight into wind and hope to pick up some lift on the way. Watch out for birds and gliders circling, and go and join them if they are not too far away. If you find lift, circle in it until it too begins to get weak, and again head up into wind.

If you want to practise thermal soaring, without having to land away from the aerodrome, you must try to operate from a point about a mile upwind of the aerodrome. Each thermal will then drift you back over the aerodrome again, and when you fail to find any more lift you will be in a position to make an ordinary circuit and landing. If you get drifted downwind of the aerodrome you will have to give up searching for lift much earlier in order to fly back against the wind to avoid landing away.

Birds are useful guides for finding thermals, but different birds use thermals for different reasons. The soaring birds like gulls, rooks and eagles, vultures and storks, etc., use the lift to save them work. They circle idly in thermals all day and are most reliable guides. Swallows and swifts usually regard thermals as hunting grounds only and do not use them for providing lift. When the thermal leaves the ground, it may go off quite violently. You have probably noticed a sharp gust of wind on a hot calm summer day which blows dust in your eyes and scatters hay, hats or newspapers all over the place? This is just a strong thermal taking off, and up with it go butter-

flies, pollen and insects. The birds pursue the insects, and you can often smell the thermal by the pollen it contains. Sometimes the smell of hay and the screaming swifts will stay with you up to nearly six thousand feet, more than a mile above the ground.

It is difficult to tell you up to what height thermals will go without producing cloud. I suppose a fair average for unstable warm days is about three thousand feet to four thousand feet, although if the ground is very damp, the cloud base may be lower. Sometimes, in exceptionally dry weather in England cloud base will go up to five to seven thousand feet, and provided that the weather stays the same, cloud base will always be higher in the afternoon than it is in the morning.

If you join another glider circling in a thermal, make your turns in the same direction so that there is less risk of running into each other. The first man sets the direction of circling.

When we talked about instruments earlier, I did not say much about how the variometer worked. Like most other flight instruments it indicates changing pressure. As you go up the air pressure gets less, and as you come down it increases. The variometer has a reservoir of ordinary air, which is insulated from heat and cold like a thermos flask.

This reservoir of air is connected by tubes to the instrument on the panel in such a way that when the glider goes up, the air flows out of the bottle and into the bottom of the tube containing the green ball and lifts it up. The more rapidly the glider rises into air of lower pressure the faster the air can come out of the bottle and the higher the green ball goes. When the glider starts to sink, the pressure of air is less in the bottle than outside and so the air wants to go back into the bottle again to

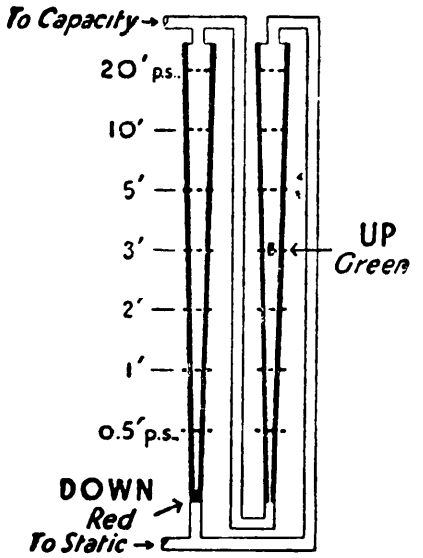


Diagram of variometer operation.

equalise the pressure. It can only do this by going through the other tube from bottom to top and lifting the red ball up, indicating sink in the process.

Naturally, the difference in air pressure is very slight, usually much too slight to be noticed by your own ears, and so the instrument is very sensitive and delicate.

There are other sorts of variometers as well as the green and red ball type. Some have a pointer on a dial, and look rather similar to your other flight instruments, but the basic principles of operation are the same.

While we are talking about soaring instruments I might as well mention the barograph. This too is operated by changing pressure, and its object is to record your flight. You have probably seen barographs in glass cases on handsome mahogany stands. The ink line on the revolving drum tells you whether the air pressure is falling and rain is likely, or the air pressure is rising and it will be fine. Glider barographs are in smaller strong

cases with a little perspex window, and the needle on the drum traces a line showing when and how fast you went up, and when and how fast you came down again. It will indicate the total time of the flight but not the time of take-off or landing. The barograph usually lives in the locker of the glider during the flight, and is not suitable for analysing your lift as it comes and goes.

Until you manage to find some lift yourself, watch other pilots circling. You will notice that it is not often necessary to do tight turns, and that the pilots whose general flying is the smoothest and most careful usually seem to be the "lucky" ones when it comes to centring quickly in lift.

Notice the height at which pilots usually stop circling in order to get back to the aerodrome, and ask them afterwards what height it was. All the time try to add to your knowledge of thermals and how to use them. Watch other pilots circle and you may notice that on one particular day most thermals seem to be found over one place. Then try to see if you can find out whether that thermal is coming up at regular intervals or not.

If you work out a theory that it is coming up at say twenty minute intervals, just before the next one is due, notice if the windsock, or nearby smoke, changes direction and blows towards where you think the thermal ought to be. Then get in a glider and go and see if you can catch one of these invisible step-ladders before it can escape.

CHAPTER ELEVEN

"C" CERTIFICATE

THE forecast is good for today. Wind light north-westerly, fine and warm, and that means there will probably be some good thermals about.

By lunch-time cloud base should be about three thousand feet. For your "C" Certificate, which is the first soaring qualification you can get, you have to climb above your launch height, or the lowest point in the flight, for not less than five minutes. This means that if you have a winch launch, you should not land in less than about fifteen minutes' time from take-off. Stay up longer if you can, but not more than forty-five minutes on your first attempt.

Get in your glider, and while you are waiting for the cable, watch the clouds and those two Olympias which have obviously found something.

After your launch turn away to the side on which you think there is more chance of finding lift, and fly round the circuit seeing what you can catch on the way.

On your first few attempts you must not circle below five hundred feet, or even higher than that if you are getting out of position for your approach and landing. Look round before you start circling, and keep count of the other gliders in the air. Off you go then, and let's see what you can make of it.

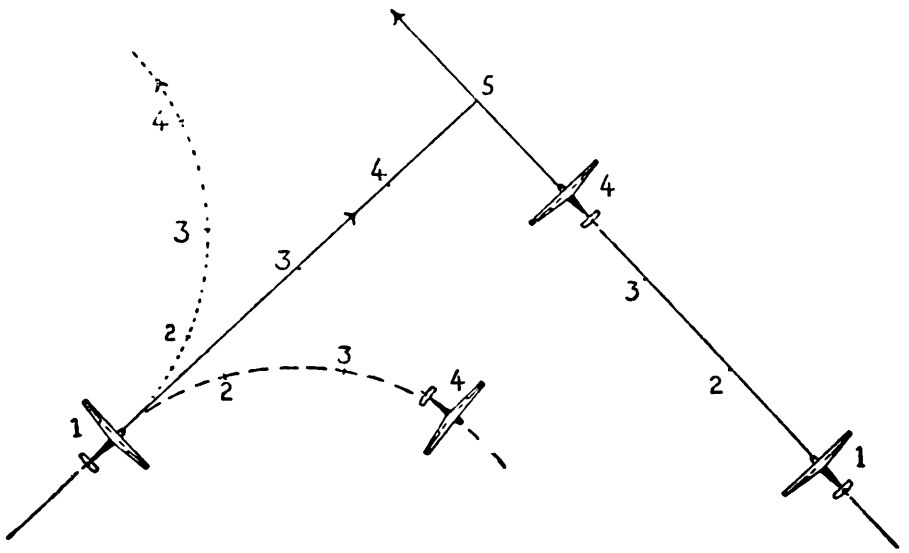
Well, you had a very good launch, it must have been nearly one thousand two hundred feet, and were extremely lucky in running into a thermal immediately you released. You were rather slow in getting properly into the lift, and

seemed to be doing circles endlessly immediately over the winch line, so that we could not launch any more gliders until you had gone away. But as this was your first attempt at soaring we forgave you.

Finally, you managed to stop flying half in and half out of the lift, and went up well. The Olympia pilot who came along and joined you said that you were two thousand eight hundred feet above the aerodrome, and as you stayed up twenty-five minutes you have certainly got the flying part of your "C" Certificate.

Now there is a duller part. Before you can start flying across-country, it is necessary to know the rules of the air, how and when you can fly in control zones, and what signals you will find displayed on aerodromes and what they mean.

These are the most important ones for you to remember.

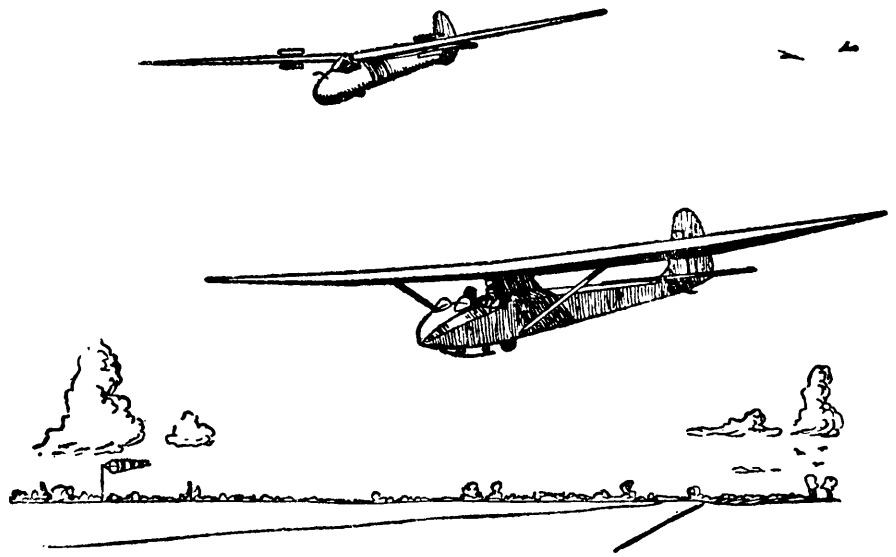


When two aircraft are on converging courses, the one on the right has right of way. Notice that if the avoiding glider turns left he ends up by flying parallel and still quite close to the glider which has right of way.

1. When two aircraft are meeting head on, each must turn away to the right, so that a collision is avoided.

2. When two aircraft are on converging courses, the aircraft on the right has right of way.

3. When one aircraft is overtaking another, the overtaking aircraft must overtake on the right and keep clear of the other.



When coming in to land, the lower glider has right of way. The glider shewn above should close his brakes and land well ahead and clear.

4. Provided that it is everyone's responsibility to avoid a collision, a glider has right of way over an aeroplane, a helicopter and an airship, but must give way to balloons.

5. When two gliders are coming in to land, the glider which is lower has right of way.

6. If a glider is landing at an aerodrome where aeroplanes are flying, the pilot must remember that aircraft should land to the right of other aircraft which have already just landed.

7. When hill soaring it is necessary to alter one of the above rules and so a convention exists as follows: An overtaking glider should always overtake on the hill side of the other glider. This is because when hill soaring all turns must be made outward from the hill, otherwise the glider will be turning into the downdraught behind the ridge.

Now for some signals. Outside the control tower of each aerodrome there is a white-framed signals square, which contains instructions to pilots. Normally all circuits are made round aerodromes in a left-hand direction, unless there is a right-handed arrow round one corner of the signals square frame.

If there is a red square within the signals frame with a yellow diagonal cross on it, this means landing is prohibited, which may be very difficult to comply with in a glider. If it only has a yellow diagonal line on it it means land with caution.

If there is a white dog's bone or dumbell in the signals square, this means land on the runways only, but unless the grass looks very rough, or is obviously corn, it may be better to land a glider on the grass than on the runway and hold up aeroplane landings until a crew has been collected to pull you off.

If, when you are coming in to land, the control tower signals a green lamp at you, this means "Go ahead and land." If red, "Landing prohibited."

Over Britain there are control zones and airways which airliners use and which must be kept clear in bad weather of any aircraft which are not in radio contact with the zone controller.

In airways and control zones you are allowed to fly at any time without telling anyone provided that you keep at least two thousand feet horizontally and five hundred

feet vertically from cloud, and that the general visibility is not less than three miles. If you cannot comply, leave the airway at once. In the special zones, like the one at London Airport, you are not allowed to enter without previous permission, and probably only then if you have radio. It is very important to comply with these regulations, as airliners do not have nearly such a good view for the pilot as you have, but he must carry the enormous responsibility of passenger's lives.

There are, of course, more regulations than the ones I have told you about here, and you will find them all in a book in the office. Read and learn them this evening, and remember that even night has a proper aeronautical definition, which is important because club gliders are usually only insured for flying by day!

By the way, I heard you asking a fellow pupil the other day why only pilots of high-performance gliders wear parachutes. The reason is that when you become experienced in soaring, you may do some cloud flying, when it is accepted practice to wear a parachute. It is rather like having a life-belt on a yacht, except that you do not wear it all the time on a yacht because you are able to move about, and anyway you would have time to put it on if anything went wrong. You always take your life-belt or life-jacket, even though you do not expect to use it. It is the same on gliders. I have not heard of a single glider pilot having to bale out in cloud in the United Kingdom, but soaring pilots still wear parachutes.

If you wear a parachute, you might as well know how to use it, so although you are not likely to go into cloud for a very long time yet, I will tell you about your parachute now.

First of all, it is important to look after it. Do not leave it lying in the wet grass, or as a wingtip weight in

the rain. The parachute has a bag, and it should be put into this as soon as you have finished flying with it.

Secondly, when you wear it, see that it fits properly and that the straps are not twisted. You are neither very tall nor fat, so you will frequently find that the parachute harness is too loose when it is your turn to fly. It is a little trouble to tighten up the straps, but very necessary to do so, even if it delays the take-off. If you ever need a parachute, you will need it badly, and it will be useless if it is not on properly or does not fit.

If you should ever want to jump out of a glider in an emergency, throw off the cockpit cover, undo your cockpit straps and then get out. If the glider is spinning go head first on the inside of the spin, and then wait as long as you dare before pulling the ripcord. The reason for this is that in a glider the pilot's weight is a very large proportion of the whole and largely makes for the stability or balance of the glider; whereas in an aeroplane, with a heavy engine, the pilot is much less important from the balance point of view. If, therefore, you jump out of your glider, it will promptly do a sort of loop, with the risk of diving into your parachute. So it is advisable to fall really clear before opening it. When you decide to pull the ripcord, unless your hand is already on it, look down on to your chest and see where it is. It is very easy when you are seeing the world from a strange tumbling point of view, to forget that the easiest and quickest way to find something is to look for it.

When you land try to face the way you are drifting, and as you touch down let yourself go limp and roll over. Then get rid of the parachute as soon as possible.

In some European countries parachuting is a sport like gliding or ski-ing, and hundreds of boys have made jumps, but in England it is not permissible to jump other than in

an emergency, without permission in writing from the Minister for Civil Aviation, so do not think you can try jumping out of the two-seater for fun one evening.

I mentioned just now landing in fields from a parachute drop, but it would be far more to the point to talk about landing gliders in fields, which is something that is much more likely to happen to you.

You have started thermal soaring now, and one day in the next few months, you will set off on your first cross-country flight. Perhaps you will go ten miles, perhaps one hundred, but sooner or later you will run out of lift, and have to land. At what height are you going to give up looking for lift and think only about landing? And what sort of field will you choose?

Almost everywhere in England there are plenty of fields good enough for landing gliders. The problem of a safe landing should not cause any worry provided that the glider is not flown low over built-up areas, or wild and rocky country as may be found in Wales, Devon or Scotland. Below two thousand feet the glider should be flown only over good landing country.

Below one thousand five hundred feet the glider should be flown only within reach of suitable fields, from which a particular field has been assessed as suitable for landing. If the glider is drifting along on the wind, neither gaining nor losing much height, a further field should be chosen before the first one has been allowed to drift away out of reach.

At one thousand feet on your first few cross-countries, stop trying to find lift and concentrate on your approach and landing. As it is necessary to land into wind, the first consideration will be to find out its direction. It will probably not change much during the course of a short cross-country flight, so it is a good idea to see where the wind is in relation to the sun before you start. You know

what the sun is going to do, so if you leave the aerodrome at lunch-time with the wind behind you, and the sun on your right wingtip, the chances are that two hours later with the sun just behind your right wingtip you will be flying approximately downwind. The cloud shadows drifting over the ground will help you, although the wind at cloud level is not usually quite the same as on the ground.

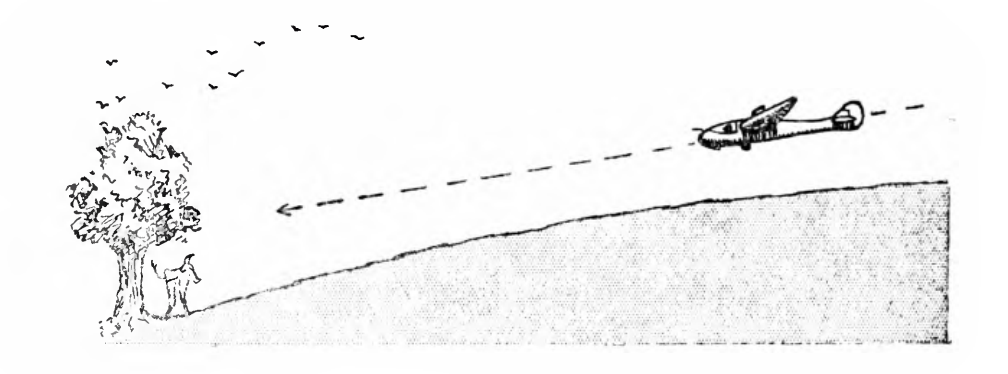
Smoke from chimneys and bonfires is fairly reliable provided they are sited in fairly open ground. The smoke from a fire in a valley may well just drift down the valley. Washing on the line is usually unreliable, but ripples in long grass or standing corn are worth looking for.

All the time you are soaring try to keep a picture of the wind direction, not only to help you to fly straight downwind to get as far as possible on your early flight, but to save having to find out what the wind is doing when you ought to be thinking about landing.

And now to choose your field. First of all look for the biggest field you can see. Then think of the three S's —Size, Slope, Surface.

It is difficult to guess size from the air to begin with. For instance, once you are in strange country, a little field surrounded by even tinier fields may lead you into thinking wrongly that it is quite big. See if you can see anything else nearby which will help you measure your field. I expect you know the length of football and cricket pitches, but they are not often placed alongside your chosen field for convenient comparison. Telegraph poles are about sixty yards apart, so there should be at least three such spacings along your field—more if there are high trees surrounding it.

Slope is very important because if you try to land in a field which slopes away from you about the same amount as your gliding angle, you will reach the far hedge before



Slope is very important!

you reach the ground. Try to pick a level field or one which slopes up into wind, and remember slope is very difficult to see from the air. In fact, if you can see that a field slopes from one thousand five hundred feet or so, it is probably too steep to land in.

There are various ways of finding out whether or not a field slopes. If a river or stream runs along one side of it, it is reasonable to assume that the field slopes down towards the water, which will be at the lowest point. For the same reason the lowest corner of a sloping field will probably be the dampest, so if the colour of grass or earth becomes deeper to one corner, that corner is probably the lowest part of the field. Remember that canals are artificial and do not necessarily even lie at ground-level, but cross above roads and and do the most unexpected things.

Now for Surface—and this is very important because it includes other people's corn, about which they are justifiably angry when it is flattened by careless glider pilots. So let us see what we can learn about the farmer's side of the picture, and find out how we can annoy him least. In the autumn, winter and spring fields are ploughed, leaving parallel furrows nearly one foot deep. These cannot be harmed by the landing glider, but they can harm

it. If you must land in a ploughed field do so only when you can land into wind along the furrows.

After ploughing comes harrowing and sowing. A well-harrowed field is perfectly all right to land on, and even if the young crop is an inch or so high, no real damage will be done by a glider landing, provided bystanders are kept out.

Even in corn a foot high, the glider will cause very little damage. It is indiscriminate walking about that flattens the young plants.

The farmer grows a variety of crops in his fields, some of which are easy to distinguish and some not. Broad-leaved crops like turnips, kale and potatoes are recognisable from corn, but corn and grass look fairly similar. If a field is to be cropped for hay, it will be long and of a fairly light bright green in May and June, and should not be landed in until it is cut. There then follows a few hours in which the field is a gloriously scented soft surfaced paradise for gliders, after which the hay is abruptly built into miniature stacks all over the field. Once the hay has been carried, the farmer probably will not mind much if you land in the field, unless the grass is nearly long enough for another cut to be taken.

Young corn crops always look a darker green than grass and do not usually start turning yellow before mid-July, after which there is absolutely no excuse for mistaking them for anything else. Standing corn, whether still green or yellow, must be avoided. It will almost certainly break the gliders' tail, if not worse, and flattening even a small patch may allow the next heavy shower to extend it until a much bigger area of the field is "lodged" or flat, and almost impossible to cut properly.

If the field is cleared stubble, then land in it to your heart's content. Remember that when you land in somebody's field you are trespassing, and it is up to you to

plan your landing with enough height in hand to avoid annoying the owners of the land, as well as ensuring that the glider is not broken in the process. When you have landed, turn your glider out of wind, and put your parachute in its bag on the wingtip. Leave gates as you find them, and in case there is any foot-and-mouth disease in the district do not walk indiscriminately from field to field. Get on to the nearest footpath and stay there. As soon as possible find the owner of the land and make your peace with him, and remember that you are the cause of any damage by sightseers trailing across the fields. Having now obviously discouraged you from ever leaving your home aerodrome, I will add that farmers and landowners are usually most generous and helpful, and rarely mind your coming down unexpectedly on their property, provided that they see that you are taking all possible precautions to avoid causing unnecessary work and trouble.

Finally, parkland and stock. Old pasture, such as you usually find in parks, is inclined to become lumpy over the years, so regard any unevenness or patchiness of colour with suspicion. If there is stock in a field, and it is congregated in a rather geometrical manner, this is probably because the grazing area is restricted by an invisible electric fence. If the stock has been temporarily taken out of the field, the eaten-down patches will be paler than the rest.

Horses usually gallop madly round the field when something strange approaches, but cows stay put until after you have landed, and then come slowly up and eat the glider—as do goats.

Lastly, you should assume that any road, over which you are going to make your final approach to land, has telegraph wires along it, even though you haven't seen them, and that there is no such thing as an isolated electricity pylon. If you see one, then go on looking until you see

the next, in order to find out the line of the cables. If they run across the far side of your chosen field, this does not matter in the least, as you will be on the ground by the time you reach them, but if they are on the approach side, choose another field.

I have talked about field landings at length because cross-country soaring is the finest and most exciting part of gliding, and the ability to land properly in fields is as important to the glider pilot as the ability to use a chisel is to a carpenter.

CHAPTER TWELVE

KNOWING THE WEATHER

ONE of the things people ask you as soon as they find out that you fly gliders is, "I expect you have to know a great deal about meteorology?"

As you know, meteorology is a science, and it would take you a very long time to learn to become a meteorologist, and although to be a good soaring pilot you do need to know something about the weather, much of it you can teach yourself by keeping your eyes open.

If you get into the habit of observing the sky, you will find that both clouds and weather systems have quite distinct life cycles and follow a recognisable pattern, but to make the most of your observing you must first learn what different clouds there are and why they exist.

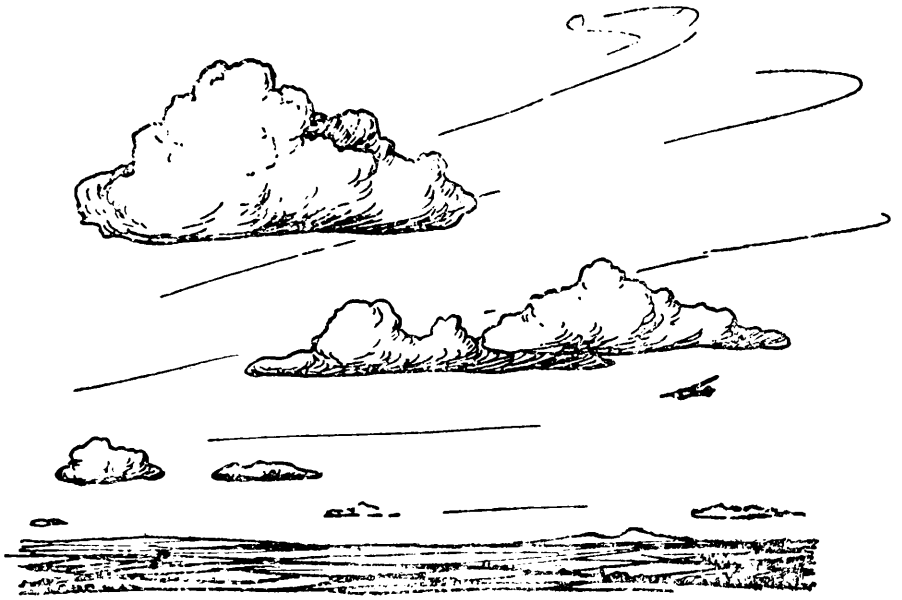
Very broadly clouds can be divided into two groups: heap clouds and layer clouds. An example of the first is the cumulus that you know show the tops of thermals.

The ordinary cumulus looks like a puffball or cauliflower. It is usually white and bright to look at with a rounded dome-like top, and a flat darker base.

If the air is very unstable, which means that it is hotter than usual near the ground and gets cool quickly as you go up, then the cumulus will grow bigger. If the weather becomes thundery the cumulus may grow huge, develop an anvil-shaped top made of ice crystals, and be called cumulo-nimbus. Good cumulus usually have their bases at about three thousand and their tops up to six to eight thousand feet, but cumulo-nimbus heads may grow up to

twenty thousand feet in England, and even higher in hot countries.

The lift under and in cumulus varies from two to three feet per second up to about ten to fifteen feet per second, but in cumulo-nimbus it may roar upwards in a violent updraught of sixty feet per second. Until you can fly



Fine weather cumulus.

blind it is as well not to hang about underneath large thunderheads idly looking for lift, as you may get sucked up into their inky wild interiors so fast that even with your brakes open you will find great difficulty in escaping. Cumulo-nimbus clouds are the heavy-weight boxers—not to be taken on without good training and plenty of courage.

The small cumulus has a life of only about twenty minutes; the thermal goes up, the cumulus forms, develops and then as the thermal becomes spent, dies away.

The cumulo-nimbus on the other hand is so big and powerful that it can start a circulation of its own. The thermal forms cloud, which grows and grows, sucking in more air from below to feed itself. It goes on growing until it becomes the stormy monster that will later start to collapse from its own inflated importance and spew sudden heavy rain over fêtes and cricket matches.

I do not think there will be any risk of that today although we should get some good ordinary cumulus. The sky is still quite clear and very blue, but it is only just after 9 a.m. and early for cumulus development.

Quite soon you will see little wisps of cloud appearing quite low down, perhaps at only one thousand feet. They will live just a minute or so, and then vanish again.

As the morning wears on, and the sun warms the earth, the cumulus will last longer and grow bigger into the familiar shape you know. But when this starts happening the cumulus shadows on the ground tend to cool the surface over which they pass and fewer thermals start up. The more cumulus that grows in the first rush of a sunny morning, the more shadows are thrown on the ground, to the extent that the sunshine may be almost entirely cut off. and no thermals develop until the existing clouds have died away. You know the sort of day I mean. It so often happens when you are going out for a picnic. The morning promises well, but by ten or eleven o'clock the sky is covered with cloud. About every two hours or so the clouds break up and the sun shines, and then more clouds appear and it becomes cool and cloudy again. It is only in the late afternoon and evening when the heat of the sun is dying away that the clouds finally disperse, but then the picnic is over and you are on your way home.

The best sort of weather for cross-country soaring exists when the cumulus development in the morning

starts more slowly, and the sky never becomes more than half covered with cloud. Under these conditions the sun is not cut off entirely from the ground, and so thermal development is steady.

In the afternoon cumulus tend to get rather larger and with bigger intervals between them, cloud base becomes higher, and often the lift is smoother than earlier in the day. Then as the heat goes from the sun, the thermals become gentler and further apart, and the cumulus grow less tall and fade away quite quickly once again. But often as evening comes and the air starts to cool, thermals come off from places which have managed to hold on to the day's warmth and sometimes the last thermals that you are able to find before you land in the early evening take you up higher than many you have found earlier in the heat of the day.

Lying in the sun and watching the clouds is a very pleasant occupation, which at gliding clubs is usually ruined by people shouting at you to go and push gliders back to the launching point. But if you get a chance, watch the baby wispy cumulus appear suddenly out of the clear sky, slowly grow into shapely castles with turrets, and then quietly change into ragged hummocks as they slowly crumble and finally disappear. You will have to watch carefully to see the life history of a cumulus, since the wind is always drifting your cloud further and further away, and your eye is attracted by the newer glittering mountains that are growing and taking their place. The lives of summer-day cumulus are very short: about eight to ten minutes to grow from nothing to full size, and then about ten to fifteen minutes to fade away and vanish.

That is why when you are soaring you must look out for the baby clouds, which are still being fed by their thermal. Once the cloud has reached its prime, however

majestic it looks, it will probably only greet your arrival with subsiding air and possibly a few drops of rain.

I have not yet told you why a cumulus cloud forms at the top of the thermal, but I will try to do so as simply as possible, although you will probably find it easy to understand if you are interested in physics and chemistry.

You have learnt that hot air rises, and as it rises it expands and cools. Air in the natural state contains moisture which is normally invisible, and hot air can hold more water in the invisible state that can cold air. As your rising thermal gets cooler, therefore, it finds that it can no longer hold the same amount of moisture as it could when it was warmer. So some of this moisture is thrown out of the cooling air in the form of millions of tiny water drops. They are much too small and light to fall as rain, but the light shining on them makes them visible to us as cloud.

The thermal goes on up into the cloud, and the act of throwing out some of the moisture produces heat, which gives the thermal inside the cloud a boost which enables it to go on up, cooling and making the cloud taller.

When the thermal is finished there is nothing left to push up the cloud and so it starts to sink back into itself, and as it subsides into slightly warmer air it starts to dissolve away.

If the air is very dry the clouds formed will be higher as the air can be cooled a great deal before it finds that it can no longer hold the little moisture that it possesses: in fact, sometimes the thermals will have reached their own equilibrium before they reach condensation level, or the height at which the air has cooled so much that it must give up its moisture.

Thermals on a cloudless day are called dry thermals, but such days are more frequent on the Continent than they are in England.

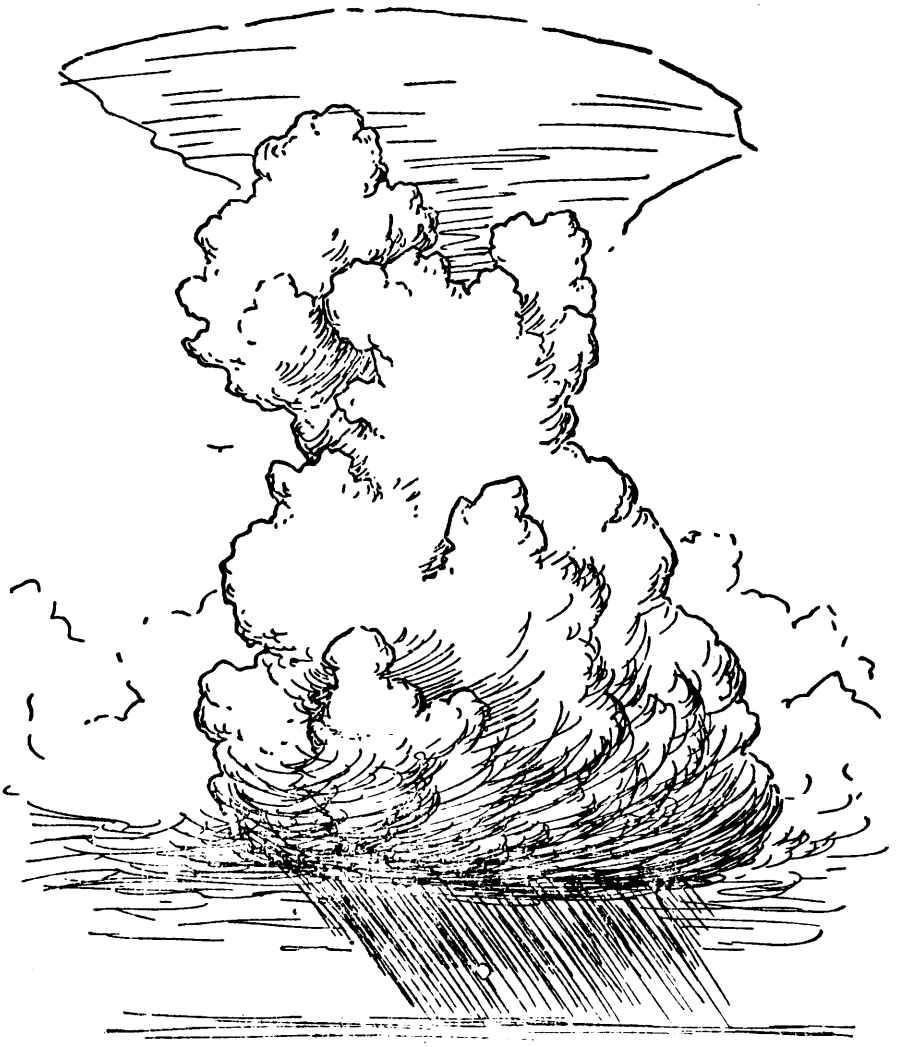
The other general groups of clouds I mentioned are layer or sheet clouds. Sometimes the sheets become broken or deteriorated into lines or irregular patterns, and they occur at a great range of heights. Very low sheet clouds are called stratus, and when stratus breaks up it is called strato-cumulus, and often looks similar to low ragged cumulus.

Alto-stratus is the continuous sheet of cloud at medium heights, and alto-cumulus clouds are the sheet broken up into a cumulus-like pattern. Alto clouds are composed of water drops like cumulus and stratus. Higher still you get sheet clouds, but due to the extreme cold of great altitude they are composed of ice crystals. Cirrus clouds are the wispy swathes across the sky which are often called "Mares' Tails," cirro-stratus the continuous icy sheet, and cirro-cumulus the broken sheet. Cirro-cumulus does not occur very often, and the delicate little ripples and patterns are very beautiful.

Lenticular clouds, which are the clouds produced by wave motion through the air, are really half-way between heap and layer clouds. They look flat and stripy, but they have appreciable depth in relation to their size.

Try to recognise examples of the clouds I have mentioned, but remember that neither the clouds nor the weather can be neatly pigeon-holed. In England you will usually see more than one type of cloud in the sky at once and on some days nearly every type of cloud will be present.

For soaring only cumulus, cumulo-nimbus and lenticular clouds can be directly used by the glider pilot. Most sheet clouds merely cut off the sun and are regarded with dislike. But sheet clouds are the visible sign of changes in the weather systems which move continuously over us, and an understanding of them will help you to know



Cumulo-nimbus, shewing the anvil of ice crystals at the top, and rain falling from the base.

what the weather is likely to be, and to understand forecasts better.

Briefly, and very simply, there are two broad types of weather system, the depression or low pressure area, and the anticyclone or high pressure area.

The depression usually has the following features in

England. Generally westerly or south-westerly winds, moderate temperature—neither extreme cold nor heat, rain or ar least dampness, and quite a lot of cloud.

The anticyclone produces mainly easterly winds, little rain and much less cloud. In winter anticyclonic weather may be severely cold, and in summer very hot. I do not propose to go into the details of weather systems, why they occur and what happens between them, as this is a subject on its own, but I will only mention a few points that may help you to link the weather forecasts with the sort of weather you want for gliding.

The depression is roughly a circulation system of winds moving round in an anti-clockwise direction. In addition, the whole depression moves across England approximately from west to east. The first signs of an approaching depression will probably be cirrus wisps in the south west sky and a backing wind.

As the depression approaches, the ordinary cumulus in which you have been trying to soar will flatten and may die out altogether, and the sheet cloud increase and get lower and lower. If the depression is young, it will produce drizzle which may be heavy and extensive, but if the depression is old and spent, only cloud may remain. This drizzle belt is associated with the warm front.

After this rain has passed, the wind may possibly veer a little, but the weather will probably remain cloudy until the weather becomes stormy and great masses of all sorts of clouds and heavy rain arrive. This is associated with the cold front. The older the depression the more the cold front catches up the warm front, and so the heavy rain is often found mixed up with the drizzle, producing the well-known English holiday weather. When the two fronts have caught up each other the whole system is decaying and the weather becomes less violent,

although widespread cloud may remain. Sometimes depressions follow each other in from the Atlantic in rapid succession, and produce wet weather day after day.

In the other weather system, the anticyclone, the winds blow round it in a clockwise direction. The winds on the outside are often very strong, but the centre may be quite calm. It contains no fronts and no violent changes of weather, but because it is a system in which the air pressure is kept high by more air sinking into it from the top, the thermals may not be very good.

Anticyclones, in spite of their tendency towards stability, are to be welcomed in England, if only to give spells of settled fine weather. Once established they can persist for long periods. Depressions come charging along and just get bounced off or deflected round the edge, perhaps for weeks, until the system has weakened or a depression more violent than the others manages to break in.

If you really want to become a fine soaring pilot, you must learn to use the weather and take advantage of all its possibilities, and you can only do this by learning about it and understanding it. You have a fine opportunity to learn from radio and television forecasts, so do not just say, "Oh, they are wrong again!" Listen carefully to what is said and then see how the weather follows the expected pattern, and if it changes try to understand why, and see if you can make your own short-term forecasts from the weather you can actually see.

CHAPTER THIRTEEN

FIRST CROSS-COUNTRY

Now that you have got your "C" and done several thermal soaring flights on your own, and now that you know a little about the weather and landing in fields, I want you to take me on a cross-country flight in the two-seater. The weather will be better in about half an hour's time, so in the meanwhile we can plan what we are going to do.

Spread out your map on the grass, and we will see to where a line running downwind from the aerodrome here takes us. The wind is north-east. This means that we will hit the coast just beyond Southampton, which is only twenty miles away, so we will have to try and fly across wind whenever possible to keep inland and perhaps reach the New Forest.

It is only possible to go with the wind when circling in lift, so it is between thermals that we will have to keep bearing up across wind towards the north. So whenever you are looking for another thermal, make for the cumulus upwind of you if possible. The wind is not very strong, and so will not help us much. Our average speed will probably not be more than twenty to twenty-five miles per hour until you are used to working thermals well, and so, provided that we can stay airborne, we could reach the Christchurch-Bournemouth area in about one and a half hours.

Fold your map as you will want it before we get in the air, and get some sandwiches, apples and chocolate, and

if possible a water-bottle. Fortunately this two-seater is enclosed and we should be quite warm, but always remember to take plenty of clothes if you are going soaring in an open glider.

Here comes our auto-tow wire now. Check controls and brakes. Wind direction north-east: time 2.30 p.m. This means that when we are flying downwind the sun will be on our left, somewhere between the wingtip and the nose. Lastly, what good clouds are there within reach? Shall we turn left or right at the top of the launch?

Yes, left looks definitely better, as there are more new-looking cumulus.

All right, then, it's all yours. Let us see how far you can make this glider go.

Twelve hundred feet from the launch. That should help us, even if you did pull up just a little steeper than you know you should have done. You have chosen a good-looking cloud to fly towards, but once you have decided where you are making for, fly straight there, unless your variometer shows you that you are running into something else on the way. At the moment you are vaguely wandering towards the cloud, and losing time and height on the way.

That is better; remember that the thermal should be straight upwind of its own cloud, so if possible fly under your cloud with the wind, rather than across it.

The red ball of the variometer is beginning to sink back to the bottom of its tube now, and you can feel that the air is disturbed. Now the green ball is flicking up and down. Wait for it; you are flying in quite a sensible place, and the lift will betray its whereabouts very soon. Keep your speed steady, and fly as accurately as possible.

Now the green ball has gone up to five feet per second, and seems fairly steady, and the roughness in the air is

less. Do not turn just yet, but try to find whether the lift is to the left or right of us. The cloud looks softer and fluffier above us to the left, and as the lift does not seem to want to pick up either wingtip, I should turn that way—about now.

Good, that was a nice turn, and the green ball stayed up all the way round the circle, although when we are facing back towards the middle of the aerodrome, the lift is weakest. Just circle steadily now, and we will see if it improves, or whether we should shift our circles a little further from the aerodrome towards the north.

This is obviously a big thermal, and as you are getting some lift all the way round each circle, concentrate on flying well and do not try to get the maximum out of the thermal until you have more soaring experience, or the chances are that you will lose the thermal altogether instead of climbing faster.

The altimeter now says we are at two thousand five hundred feet. We set it at five hundred feet which is the height of the aerodrome above sea-level, so we are now two thousand feet above the field, approximately twice the height of the normal winch launch. You are circling well in this thermal, and the variometer is showing about five to eight feet per second rise, but because the wind is fairly light, we have not been drifted far from the aerodrome. It looks as if the cloud base is about three thousand five hundred feet, and by the way this thermal is going we should have no difficulty in getting up there. Nearly three thousand feet now, and an Olympia has joined our thermal about one thousand feet below us. I will keep an eye on him, but I expect he will drop out of the bottom of it and have to go and find a newer one.

We are nearly up to cloud base now; see how the cloud hangs down all round us, like a fringe, while we

still climb in clear air into a sort of dome. Although cumulus look flat-bottomed from the ground, they often have concave under-surfaces when you get up to them. Some pilots say it is like climbing up into a huge bell. Notice how the cloud has lost its firm bright appearance and from close to looks like grey wintry fog.

During the time you are climbing in a thermal you should be studying the sky so that you know what you are going to do when your thermal collapses, or you lose it. If you wait until you are at cloud base, you will waste precious height wandering about aimlessly until you have decided what to do.

We must leave this thermal now, otherwise we will be sucked into cloud, so turn down wind, and fly as straight as you can until you have made up your mind.

This is the most difficult but exciting moment of the flight when you are alone. If you turn back now you can land on your home aerodrome, among familiar surroundings, but if you delay or turn downwind, there is no going back. The wind is drifting you away all the time and to return is impossible. You will have to land in a strange field, and it might as well be as far from home as possible.

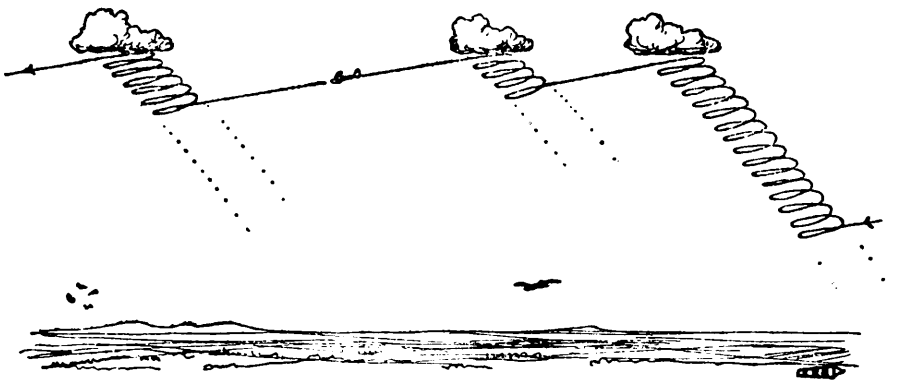
Because the wind is light today, we could still glide back from here, but we are not going to. The sea is twenty-five miles away and we are going to try to reach it. So take one last look as the aerodrome fades into the fields and woods of Hampshire, and then set course. The sun should be to the left of our nose, but the smoke from that heath fire gives us a more accurate direction.

Now what are you going to do?

Height three thousand feet. Cumulus ahead, but none to the right of our track where we would like it to be. There are two clouds ahead, and I think you have decided

to make for the bigger one with the cauliflower top, when it would be better to go for the little one which is still growing.

You can see from this height the dappled pattern of the clouds on the ground, and if you watch them drift along a road or railway line, you can get a good indication of whether you are flying straight downwind or not.



Hopping from cloud to cloud on a cross-country flight.

We are quite near our cloud now, which is still growing quite fast, although the other one is collapsing. The lift is on our side of the cloud as we are approaching it with the wind, and although the cloud is nearly one thousand feet higher than we are, we should run into its thermal trail any minute now, so watch the variometer carefully. It is still showing five feet per second sink, but the little red ball is becoming less steady and is now starting to fall back to the bottom of its tube.

The green ball has shot up and fallen back, accompanied by a bump up under our left wingtip. Red ball again. Start turning left, and do a large steady circle. I think we have flown past the thermal away to our left. Yes, we got some lift again on the far side of our circle facing back towards the aerodrome, which is only just

visible in the distance. Do another circle and see if the same thing happens. Yes, the lift is definitely still to our left and upwind of us. We must have flown just past the thermal and are trying to circle into it from underneath its slope. This time open up your circle and fly straight about sixty degrees before you are facing back towards the aerodrome and if the lift increases, count three and then start circling steadily left again. That is better, we are now getting lift about half-way round the circle. See if your next circle is any better, and if not, extend your circle again. That's fine, we are nearly completely in the lift now, but you are flying too slowly, and if you are not careful you will stall and probably lose the thermal.

Circle carefully now, but try to spare some time for looking for suitable clouds ahead and to the right of our course, as we are getting near the coast, and must work inland if our flight is not to end too soon. If you look ahead and to the left you can see Southampton Water and the Solent quite clearly, as well as the blue hilly shape of the Isle of Wight. The sea looks silvery from this distance and Southampton rather smoky. That greyness far in the distance ahead is the New Forest, which we want to reach if we can, but we will have to work across wind to do it.

This thermal is not giving us very strong lift, but it is worth sticking to it as long as it goes on giving us any lift at all. When you are very good at cross-country gliding, it may pay you to leave weak thermals and go and find something better, so as to keep up a higher average speed, but speed is not important today so you just go on climbing steadily to cloud base if possible.

We are back to three thousand feet now and it is just possible to see the coast as far as Christchurch; that town away to our right is Romsey. You can just see the Abbey if you look carefully.

Our track line lies over Southampton, but we want to pick up our next thermal to the north of the town to counteract the northerly wind, as well as to keep away from the built-up area. If we find no lift there is an aerodrome at Eastleigh, this side of Southampton, which we could use if necessary.

Now we are nearly up to cloud base again; it looks higher this time at almost three thousand eight hundred feet, but our cloud has become ragged and rather old and seems joined up with quite a number of other clouds, so that a large area of ground underneath is in shadow. There is some sunshine away to the north-west in the direction of Romsey, so you had better fly towards it although it is rather far away. With any luck we may run into some lift before we get there.

It will pay you to fly a little faster than usual through the downdraught area, about forty-five miles per hour or even fifty if the sink is considerable. Do not wander about; pick some landmark in the far distance and fly straight towards it.

You can see Southampton quite clearly now, but it is in shadow, too. However, it would be useless making straight for it as we would be too low when we got there to do anything but land.

We are down to two thousand five hundred feet now, and the air seems quite flat and lifeless. This big cloudy area is stopping any thermals from starting, and unless we can get to the sunshine ahead we may well have to land.

Two thousand feet and still nothing; however there are plenty of good fields underneath and ahead, and so landing need not worry us for a while.

Look, the green ball has jumped up. There must be lift somewhere here. Turn to the right and see if we can get it again. Yes, there it is, circle carefully now—three

to five feet per second. Now it has gone again, and the red ball is showing sink. Do another circle, and open it out a little when you are pointing towards Southampton Water. No luck. Do one more wide circle, and if we don't strike lift we will go on our way and not waste any more of our precious height on it.

Nothing at all. Either that was just an odd little bit of lift or we were not very clever at searching it out. So make for that sunshine again, and let's hope that we get there with height enough to make use of anything we find.

One thousand eight hundred feet. There are still good fields within reach although the sprawl of Southampton's outskirts is beginning to limit our choice a little. This cloudy patch above us is beginning to decay now, and so the sun may start to break through soon, which will help.

One thousand five hundred feet. We haven't a great deal of height in hand now and must seriously consider landing-places. There are three fields together about a mile ahead which look possible; I think they are grass, but I cannot be sure yet. Two of them are lighter green than the third, and one of these has cows in it. What do you make of the three fields?

Yes. They appear to slope up into wind which is good, but the trees on the approach look like old elms, and are probably very tall.

The darker green field is almost certainly corn. It has an evenness of colour, and is rippling slightly in the wind, whereas there are no ripples in the other two fields. The field without the cows is quite large. I should think about a 300-yard run into wind. The grass is worn bare in what is probably the gateway, and I am pretty sure now it is a cleared hayfield.

One thousand three hundred feet. The sun is shining now on that village ahead, but I cannot see anywhere

suitable for landing nearby. However, it would be possible to get back to our field, if we did not stay over the village below eight hundred feet. Fly straight to the village and see if there is any lift just beyond it, then if we find nothing we will come straight back here and land.

Still nothing, but at least we are out in the sunshine again. I do not think anyone in the village saw us as we passed over, although there were several people out in the street looking at a blue racing car.

One thousand feet, which is probably only eight hundred feet above the ground and still nothing. Wait a moment. The green ball is flickering into life, and the air is feeling lively again. But if we do not get lift on our first circle, we'll have to give up and go back and land. Carefully now, fly as well as you possibly can. Get the speed just right. Now start turning—the green ball is steady now at one foot per second up. It is incredibly weak, but enough to keep us airborne if you do not lose it. If you can hang on, the lift will improve as we get higher, but do not breathe for the next few circles.

Well, you are managing to stay in the lift, but all it is doing is drifting us away from our chosen field, without giving us practically anything in the way of height. If you were alone, you should stop circling at once and go back to that field, but as it is the instructor's fault if you break the glider, I think we will go on as I can see a small field ahead which will do to land in if necessary.

Well, we have gained one hundred feet at the expense of losing a safe landing-place, but the lift is very steady if pathetically weak, and I think it will build up into something worth having if you go on flying as you are now.

That is better. One thousand five hundred feet, and the lift has increased to five to eight feet per second. If

you look up you will see that a tiny cloud is beginning to form at the top of where our thermal is.

Two thousand feet and the immediate panic is over. Once again you can spare a moment to look at the wonderful view that you can get from a glider. Do you see those yachts racing off Calshot? A few years ago they nearly all had white sails, now there are all colours.

This thermal is really getting going now, and we are nearly back at three thousand feet. The lift is getting up to ten feet per second and the cloud is still a good way above us. It is growing fast, and must look wonderful from the ground although from here it just looks dark and misty.

Nearly four thousand feet, and still not in cloud. This is excellent. Look at those Meteors far below us. I can see twelve of them in the formation, and you can just hear them above the gentle whistle of our glider.

Now we are past Southampton Water, and there is a big liner on its way out, towed by tugs looking like those "water-boatmen" you see on stagnant ponds.

From this height we will cross most of the wooded area ahead without any trouble even if we do not pick up any lift on the way.

We still want to try to fly cross wind between thermals to avoid reaching the coast too soon, but with any luck we should make Christchurch aerodrome.

Yes, here we are, more lift, and we are still just over three thousand feet. This is travelling the easy way, but we deserve it after that last struggle to stay up near that village, and it is certainly giving you some practice in doing turns. They are getting quite presentable.

Three thousand nine hundred feet again, but we are nearly up to cloud, so we will set course again as the sky is looking really good now.

This part of Hampshire is very beautiful, and it probably surprises you to see how much of the New Forest area is open cultivated land with good places to land.

We are getting quite close to the coast now, and you can see Christchurch harbour in the distance. It is a most attractive harbour from the air, and looks excellent for small boat sailing. There is an aerodrome just this side of it where the A.T.C. do some gliding, which will save us looking for a field if you can manage to keep soaring.

You are beginning to fly too slowly again. As you get better at circling, there is a great temptation to fly slower and slower, so watch your speed, and do not lose your thermal by stalling out of it.

More lift, and again above three thousand feet. It is always easier to find lift if you can keep high as the thermals are bigger, and you have a wider radius of action as you are not tied to keeping near good fields.

You can see the aerodrome now. When we arrive, make a circuit in the usual way—left-handed, and see that you do not land on their winch line. You will not be very popular if you stop them launching until they have pushed you out of the way!

The aerodrome still looks a long way off but we have plenty of height to get there in a straight glide. Remember with this wind behind us our effective gliding angle is about 1 in 30. This means that we can go nearly twelve miles from our present height and the aerodrome is only four miles away.

That is fine. You have started to make your circuit from one thousand feet, just as though you have had a winch launch out of the field. Just make your usual circuit and land by those buildings on the north side, and make the best landing you can.

Well, we are down now, and you can start getting rid of that cramp in your fingers. You have been gripping that stick too tightly ever since we got out of reach of our own aerodrome, but I knew it would be useless telling you to relax. That is something you can do when you go on your next cross-country flight—by yourself.

Next time you will be your own master, and whether you reach Cornwall or only the next village, you will have got there by your wits alone.

CHAPTER FOURTEEN

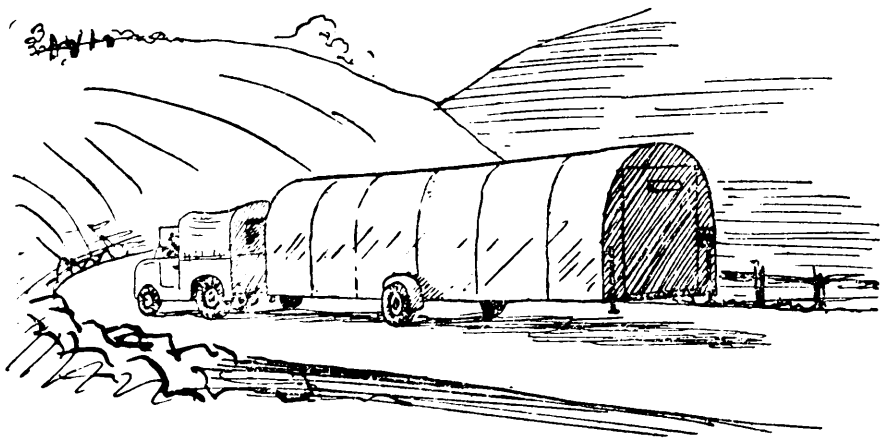
RETRIEVING, AERO-TOWING, AEROBATICS AND NAVIGATION

WHEN a glider lands away it can be retrieved by one of two methods: aeroplane tow, or car and trailer. Aero-tow is much quicker, but can only be used if the glider lands in a large field or aerodrome, in reasonable weather, and by day. It is also more expensive.

Most retrieving is done by car and trailer. Each gliding club possesses the necessary trailers in which the dismantled gliders can be put and towed home.

We will telephone back to the club and in a few hours the club car will arrive with the two-seater trailer.

Almost all trailers in England are fully enclosed, so that the glider is protected against the weather, and also so that they can be used to store the glider properly if hangar



Trailing home.

space is not available. They are boxes about twenty-five to thirty feet long, with a single pair of wheels. The wheels must have automatic braking. This is usually effected by a simple overrun mechanism: when the car stops the trailer continues to run into the back of it, and pushes a lever which puts on the trailer brakes. The body of the trailer is covered with aluminium, plywood or hardboard with doors at each end. The tow-bar height should be sixteen inches above the ground.

On the Continent, where the weather is drier, open trailers are often used. These are cheaper and lighter, but of course leave the glider exposed.

While we are waiting for the trailer, we will get the glider dismantled. Help me to pull it near the shed here, and I will show you how it comes to pieces. We will want two more helpers.

First of all we will take off any fairings, such as the strip of ply over the centre section, and the little fairing in front of the rudder, and put them in the cockpit so that they will not get lost or damaged.

Now we will disconnect the controls, first of all the elevator just underneath the fin, and then the ailerons and the airbrakes at the centre section. This we can do by ourselves without bothering anyone else, but in a strong wind it is unwise to disconnect the controls unless you are going to finish the job of de-rigging straight away, otherwise some damage may be caused by the wind blowing the control surfaces about.

We can also take the tailplane off by ourselves, but we must put it in a sensible place so that it will not get trodden on or be blown away. I should think near the wall here on the grass, with one of our parachutes to weight it down. Now we must get some help to lift the wings off.

You stand by the cockpit, and hold the fuselage upright.

Each of our helpers will lift the wingtips while I disconnect the main pins at the wing roots, so that the wingtips can be lowered to the ground. Then we will take the wings off and lay the fuselage on its side.

We will put all the pins back in their own fittings and lock them in.

Lastly, weight down the wings with something suitable, stop the barograph and if you are in a strange field, make sure, before you go away, that a herd of cows will not be turned into it after milking time.

We could not have an aero-tow back today, as the aeroplane is busy towing up gliders at the club, and as soon as possible will go to the Bristol club to retrieve an Olympia, but there is no reason why I should not brief you how to be towed behind an aeroplane in order to save some time when the opportunity occurs.

First of all aero-towing is both safe and pleasant, but before you start you should learn the two signals which may be used between the tug and glider pilot in the absence of radio.

First of all, if the tug pilot waggles his wings, this is an order to the glider pilot to release at once, however inconvenient it may seem.

The glider pilot is always in a better position to make an emergency landing than the tug pilot, and in the event of engine trouble soon after take-off, for instance, prompt releasing by the glider pilot may save the tug from an accident. In such an event, the tug pilot can release his end of the cable as well, but this is no reason for the glider pilot not to obey the order given at once.

The second signal is one from the glider pilot to the tug. If the glider pilot finds he cannot release his end of the cable (and this has never happened in England) he flies out to the left and waggles his wings. The tug

pilot will feel the aeroplane's tail being pulled and look round. The left side is chosen as the first pilot sits in the left-hand seat of an aeroplane and gets a better view back in that direction.

On receipt of this signal the tug pilot must fly back to the aerodrome and release his end of the cable in a suitable position above the field for the glider pilot to be able to make a safe landing in spite of trailing the tow rope.

As regards signals for take-off, these are the same as for winch-launching or auto-towing.

The ropes we use here are nylon, which stretch and give a very comfortable smooth tow. The rope should be hooked on at both ends only when both pilots are ready for take-off—and incidentally there is a very sensible regulation that both tug and glider pilots may not both be doing their first tow at the same time.

As soon as the tow rope is taut, and the "All out" signal has been given, the tug pilot will open his throttle fully, and proceed to take off. The glider will run along the ground gathering speed, and normally get airborne first. You should then climb up out of the slipstream to about ten feet and stay there so as to allow the tug to get airborne as quickly as possible.

If you climb higher you will tend to hold up the tail of the tug which will make it more difficult to get in the air quickly.

As soon as the tug is properly airborne it will start to climb, and seeing this you should climb too, otherwise you may get left behind down in the slipstream.

The tug will fly at about 60 m.p.h., climbing steadily, and you should try to stay straight behind with the top of the wing of the tug a little below the horizon—about half its span below is an easy way of checking.

When the tug turns, you should make a normal turn

too, but trying to keep straight in line behind the tug. This actually means that you try to edge out slightly on the turn, keeping in such a position that you are always looking along the line of the tug's fuselage.

If you get badly out of position behind the tug then ease the glider back gently and slowly into the right position. Do not hurry this, and do not bother unduly about droops in the cable, they will get sorted out as you regain your proper place. When the cable does come up tight again, you may get a great surge forward, so concentrate on getting and keeping the glider in its correct position behind the tug. The nylon rope will soon damp out the surging.

On ordinary tows the tug pilot will take you up to about two thousand feet and then signal you to release. For your first tow calm weather will be chosen, probably the early evening, and the tug pilot will keep close to the aerodrome so that there is no excuse for you to lose it, and he will wave you off up wind of it in such a way that you can see it easily.

After releasing, turn away left so that the tug pilot can be absolutely certain without delay that you are no longer attached.

Aero-towing has the great advantage over winching that the tug pilot can find a thermal for you. If you see

Aero-towing—High tow position.

the tug suddenly go up do not release at once, but wait until you begin to feel the disturbed air. Having released you may find it necessary to do a climbing turn straight away, both to keep in the thermal and to slow down from the higher towing speed to your best circling speed before you fly out of the far side of the thermal.

On cross-country tows the low tow position may be found more satisfactory, but low towing should not be done unless the tug pilot has agreed before the flight starts. The reason for this is that in the low tow position the glider may be invisible to the tug pilot behind his tailplane. In any case you must come up to the high tow position before releasing so that the tug pilot can actually see you go.

To go into low tow position, fly gradually downward straight through the slipstream, and steady in a position just clear of and underneath it. The tug looks horribly high up in the air, but the towing position is a comfortable and steady one.

After you have done some aero-tows and are ready to go on a cross-country flight on your own, you must consider the little matter of navigation. In gliders this is a simple straightforward affair, and largely means having sensible maps and knowing how to read them in conjunction with a compass.

The best map for you to start with is the $\frac{1}{4}$" to the mile aviation edition of the Ordnance Survey. This can be got in paper sheets fairly cheaply, and should be folded or stuck together in such a way that you can go at least fifty miles in any direction from your home field without having to search the cockpit for another sheet.

Draw circles on your map at suitable distances, say every twenty miles, from your base, and in addition draw one or two lines which show directions in which you can get furthest before reaching the coast.

Another suitable map is the half-million aviation map. The scale is about eight miles to the inch, and although there is much less detail it is really a better map for long distances, as it is much easier to handle in the air. You should mark the Airways and Control Zones on all your maps and every now and again refresh your memory on the regulations concerning them.

Spend as much time as possible studying your map, and try to recognise distant hills and towns from your local flights and check them against the map.

It is very easy to get lost, and although this is not a serious matter in a glider, you want to learn to be able to recognise your whereabouts quickly from a map if you are going to become a really good soaring pilot, or go in for competition flying. You cannot get too much practice doing this, and do not ever try to persuade yourself hopefully that Oxford must be Cambridge although one of the railways seems to have disappeared since the map was drawn. In general, maps are always correct, and it is wishful thinking which causes confusion.

Compasses used in gliders are usually of the goldfish bowl type in which your bearing figure swims into view, and is soon gone again unless you have learnt to fly straight. Whenever you have any height to spare, try to fly an accurate compass course if only for one minute at a time. You will find it needs more practice than you think.

I will not go into the problems of variation and deviation here, you will find them fully explained in any book on elementary navigation. In a glider you want to decide where you are going, by eye and by map, and then use your compass to help you get there accurately, and to give you quickly your general direction to fly between thermals. This is especially useful in cloud, as when you decide to leave the cloud you can turn on to your known compass

course and fly out of cloud knowing that every minute is helping you on your way.

On the days when you fail to get away on a cross-country flight, or the weather only clears in the evening, you may get a sudden urge to do some aerobatics.

Aerobatics are good for your flying, and are great fun provided they are done with care and sense. They should not be attempted if there are a number of other gliders in the vicinity, and early aerobatics should never be done at less than two thousand five hundred feet.

Slow rolls are not practical on most gliders, but loops are great fun and quite easy to do.

First of all look round properly to see that there are no other gliders about, then dive to about 80 m.p.h. or whatever speed your instructor has told you for the particular glider. Then ease the stick steadily and smoothly back, keeping the wings level, and the glider straight. Go on bringing the stick back; and as the earth disappears look straight up and back until it appears again, and ease the stick forward to stop the nose coming up above the horizon for the second time round. Do not try continuous loops, until you have done several separate ones, and do not do too many in the same flight in case you make yourself feel dizzy or sick.

If you want your loops to look nice from the ground avoid doing them cross-wind, as this gives them a crooked appearance.

Aeroplane pilots will tell you that a stalled turn is easy to learn and fun to do. This is true for aeroplanes, but a genuine stalled turn should never be done on gliders. The reason for this is that if you are late putting on rudder, the glider will start to do a tail slide. This produces severe loads on the control surfaces, and has been known to result in structural damage.

On gliders, a somewhat similar manœuvre, which is actually prettier to watch, is the chandelle. This is a turn which is steep in both climbing and turning, and if done correctly you will sit fairly and squarely in your seat throughout. Dive down and pick up speed, about 70 m.p.h., bring the nose up gradually above the horizon at the same time doing a turn. Go on increasing the angle of bank until it is vertical or over the vertical, at the same time keeping the turn correct. Having got to this position allow the nose to drop and while still turning, reduce the angle of bank. If done correctly you should come out facing the opposite direction to which you started.

The important thing about doing aerobatics in gliders is to make them smooth and flowing. There is little noise, and the abrupt and more violent manœuvres which aeroplanes can be persuaded to do are out of place. There are few things more beautiful to watch than really good aerobatics done in a brightly coloured glider against a blue summer sky.

Perhaps one day you will be able to do aerobatics well enough not only to give yourself great pleasure, but also those who are watching from the ground.

CHAPTER FIFTEEN

CHAMPIONSHIPS

So far we have only talked about gliding as an individual and team sport in a club. First of all elementary training to first solo, and then soaring, until you can set off across country and fly to distant places.

As you become more skilled you will be allowed to take up passengers, learn to be an instructor and perhaps enter the National Championships to represent your club.

Championship flying is great fun, and if you are ever chosen to fly for your country in the World Championships, which are held every two years, you will see gliding in its most exciting form.

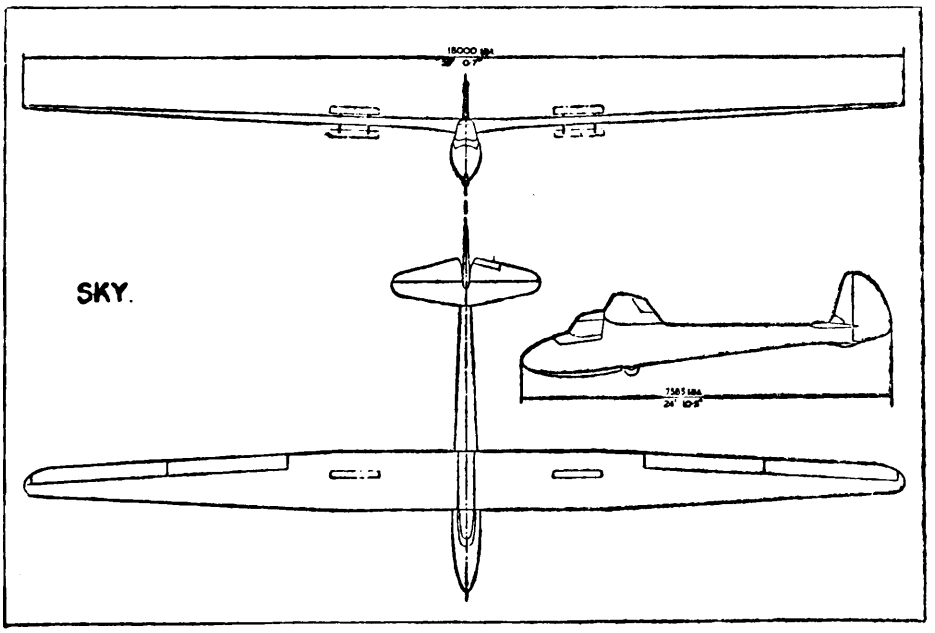
There are no amateurs or professionals in gliding. All Championships are between the best pilots, flying their best machines. Most of the leading pilots in each country know many of the other pilots who will enter, and so there is plenty of keen rivalry, combined with great friendship.

The standard of soaring in World Championships is very high, and most pilots need only one launch to get up and away. Owing to the ability of the modern glider pilot to stay in the air for six to eight hours and cover great distances, it is no longer possible for distance flights only to be flown as used to be the case. If you can imagine flying cross-country for six to eight hours each day, and then driving a couple of hundred miles home each night, perhaps for several consecutive days, you can understand that the pilot with the best physical endurance would win.

Now a task is set for each day's flying which may be a race to a goal selected by the competition organizers, a distance flight along a set course, an out-and-return or triangular race, or an all out distance test in any direction.

No longer are marks given for height, or for ordinary endurance flying. The accent is on high speed soaring, and cross-country speeds of 50 m.p.h. or over are obtained. As you can imagine, as soon as the glider pilot is in reach of his goal aerodrome, he wastes no time but dives straight for the finishing line often crossing it at over 100 m.p.h. I have seen nine gliders appear as tiny specks in the hazy blue sky and dive across the aerodrome together like a shoal of great winged fish.

At present there are two classes in World Championships, single seaters and two-seaters, and at the finish there are two World Champions, one for each class. As the



The Slingsby Sky—high performance glider which won the 1952 World Championships in Spain.

tendency is to build more and more two-seaters instead of single-seaters, it is possible that it will be found better to have only one class, when it will be up to the pilots concerned to decide whether to take a crew or not. In two-seater championship soaring the flying is not often shared between the two pilots, even though they may both be equally skilled. There is plenty of work for the second man to do navigating, operating the radio and working out actual rates of climb and true gliding angles, so that the average speed for the flight may be kept as high as possible.

Before you go in for even National Championship flying as a pilot, you should go as a crewman for someone else. Crewing is great fun and I will try to describe the sort of holiday you would have.

The National Championships are usually organized as a camp with the competitors living in tents or caravans, and either eating in a central marquee or doing their own cooking to save money. There is usually a great deal of laughter and large quantities of sausages are fried. There are even fireworks to brighten up the quieter evenings.

Early every morning you get up and rig the glider ready for the day's flying and check over barographs and radio if you are using them, put the parachute in the cockpit and pack sandwiches.

After breakfast comes briefing, when the pilots are told the task for the day, and if it is an out or return or triangular race, the arrangements made for observation at the turning point—usually unknown letters or numbers set out behind a building or hangar, with the letters changed at intervals. The pilot must observe the letters and the time at which he saw them before starting to return home. In addition, observers with binoculars watch the sky and note down any gliders seen.

When the task has been set the meteorologists give an

estimate of the day's weather conditions, and after questions the pilots disperse to make final plans with their crews.

If the task set is pilot selected goal, maps are laid out on the grass under the shade of the gliders' wings and the pilot with his crew try to assess which goal they will declare. If the goal chosen is not a great distance away and the weather turns out better than expected, then the pilot may arrive with several hours' soaring weather left, which he must waste because no points are given for overflying the goal. If, however, a very ambitious goal is chosen, it may be impossible to reach it.

The selected goal has to be declared in writing before the pilot takes off, and so he must try very hard to choose more wisely than his rivals, and then get there.

The gliders are all launched by the same method, either winch or aero-tow, and as soon after each other as possible so as to give every pilot a similar chance. The line up at the start is an impressive as well as a pretty sight, as up to fifty gaily coloured gliders may be competing.

As soon as the pilot starts, his crew with the car and trailer set off along roads approximating to the declared direction. If there is radio contact between them it is often possible to keep in constant touch, particularly on light wind days; but without radio the crew will have to telephone back to base about every hour for news. This is important, as, if the pilot lands only a short distance from the starting place, it may be possible to retrieve him quickly and get him launched again on a second and more successful attempt.

At the end of each day's flying points are given to each pilot according to his performance, the best pilot getting one hundred per cent and the other pilots in proportion. At the end of the Championships the pilot with the highest total number of points is declared the winner.

The National Championships are often held on a hill top site in the North Midlands in July, so come with me in my two-seater on an out-and-return race. I will not expect you to do all the jobs of a skilled co-pilot, but you can try to keep track of our position by map, and I will shew you how to use the radio to keep in touch with our crew.

This is our glider and there are five others to take off before us. All launches are by winch which takes the glider to five to six hundred feet above the hill top and about one thousand one hundred feet above the valley.

You sit in the back seat, do up the straps and put on the earphone for the radio. Here are the switches; this one turns the radio on, and you press this one when you want to speak.

Our call sign is Falcon and the call sign of our crew is Joker. The task is an out-and-return to Wilmslow, forty miles each way, and I have drawn a line on your map. Now the gliders before us are being launched, and so we must pull ours into line, so that we are ready as soon as the cable comes back. Stay in your seat, there are plenty of helpers.

Our crew will leave as soon as we are airborne, drive clear of the site and wait for us to contact them. Here is our cable, then. Hook on. Time 11.35.

I am releasing at four hundred feet over the ridge and turning along the slope. The two gliders which were launched immediately before us have worked their way up about three hundred feet above us, but we must watch out for that Sky single-seater. Its pilot went up in a poor thermal, and then decided to come back to the hill and wait until a better one turned up before setting course. He is close below and behind us, so we must not turn suddenly in case we run into him.

The slope lift is good today and we are already at one thousand feet over the hill, and can fly out upwind

over the valley to look for a thermal. This is better than picking up a thermal directly above the hill, because we do not want to be drifted behind the hill without enough height to return to the slope lift if our thermal peters out. If we pick up a thermal out over the valley, and it does not give us a great deal of height, we will probably be still above the slope itself when we decide to give it up and look for a better one.

Do you see that large blue and cream glider circling on our left? It is flown by a man called Chris. He has got some strong lift, so let us go and join him in his right hand circles. He is not far above us, and our glider climbs in thermals better than his, so we will soon be chasing each other's tails. Do not be alarmed at seeing another glider so close. Most glider pilots are used to circling in flocks, and I have seen as many as fifteen gliders all scrambling for the same bit of lift.

This is a fine thermal—ten feet per second, steady, but as soon as we get to three thousand feet and it begins to weaken we will start for our goal. The wind is west today and our goal is almost dead upwind of us, so our outward flight will be very slow. It pays to circle in thermals as slowly as reasonably possible in order to get a fairly small turning circle and to use the minimum sinking speed of the glider to its best advantage. We are nearly at three thousand feet now, and Chris has turned and is streaking away in the direction of our goal. Although we are not quite as high as I wanted to be before leaving, we will follow him, and use him as a sort of thermal detector. If he starts circling again we will go and join him, but if not we will pick up something on our own. He is obviously making for the left of those two cumulus, so we will make for the right, and we will see which thermal is the better.

Contact our crew now on the radio and tell them we are at three thousand feet and setting course due west.

We must increase speed now so as to remain in the downdraught area for as short a time as possible.

Old Chris is gaining on us now, as he has a better performance than us at high speeds, although we are better than him at low thermal circling speeds. His gliding angle is about 1 : 33 and ours is about 1 : 29.

We are getting quite close to our cloud now, but we must remember that because we are flying into wind and not with the wind, the thermal trails down from the far side of it, and so we will probably have to fly right underneath the cloud before we get any lift, as we are about one thousand feet lower than its base. I think we must be getting very near now as the air is beginning to feel bubbly and alive. But how is the other glider doing? Oh, he has found nothing under his cloud, and although he has lost quite a lot of height he is coming over to see what we have got.

It is another good thermal. We will slow down and circle as rapidly as possible back to three thousand feet, and with any luck we will now leave Chris behind, unless he is cleverer than I am at finding the centre of this thermal. Contact our crew again and tell them that we are climbing at two thousand eight hundred feet over Castlebridge, six miles out. This into wind leg is going to be a hard slow flight, but the thermals at present are very good. It is often difficult to know whether to keep fairly low when flying against the wind, or to go as high as possible, with long straight glides in between. In general the wind gets stronger as you go higher, and may slow you down severely, but if you stay too low the thermals may be weaker and you may waste more time looking for them as they are smaller as well.

I think we will try to operate between two thousand five hundred and four thousand feet, and not go into cloud unless the sky ahead looks dead and we want to get extra height to cross the bad area.

Have you any news from our crew? Good. They are driving along the main road and have just stopped to buy some ice-creams—would we like some? Kindly tell them we will hold them to that when we land on our return, but in the meantime we are at three thousand eight hundred feet and on course making about 20 m.p.h. ground speed.

The country over which we are flying is quite different from the comfortable open farmland and woods of Hampshire. Here in Derbyshire the hills are high and steep and the fields in the valleys divided by stone walls. We have hilly country nearly all the way between us and our turning point, and so we do not want to get low or we will have to waste valuable height and time keeping in reach of safe landing fields.

Look far below us now, on the left, and you will see a red glider. It looks as though it is crawling along on the ground, although it is probably still about one thousand feet up. The pilot will probably have to land soon unless he is very lucky and picks up a thermal at the last minute. There are some good fields along the river valley nearby so he will be all right.

I think the red glider was one of the two which went off just before us. I haven't seen any signs of the other one, and Chris should be well behind us now.

Can you pin-point our position on the map? We are just short of the big town with five railways radiating from it and a fairly broad river just west of it. Keep careful watch on our position as the turning point aerodrome will be coming in view fairly soon. Also keep an eye out for other gliders and contact our crew on the

radio. Tell them we are at three thousand six hundred feet on course five miles short of the goal.

We will just work this thermal up to cloud base which is probably about four thousand five hundred feet, and then go as fast as possible for the turning point. I want you to look out for the letters on the ground which will be displayed between the two large hangars, and take the time on your watch.

Can you see the aerodrome ahead now? Just concentrate on watching for the letters with one eye, and looking out for other gliders with the other.

Can you see them yet? We are rather high, and the air is hazy, but I do not want to go lower unless we must. They look like AR, or is it AB? I think it is AB. What do you think? AB, too. Good, we'll settle for AB. Time 13.40. So the outward trip took us two hours forty minutes. That is very slow, but we should do a lot better going home. Let's have a sandwich and some chocolate to celebrate.

Look, there is Chris above, and even ahead of us on his return. When did he pass us? I thought we had left him far behind. He must have gone high in a good cloud and come diving over us a great deal higher.

Contact the crew and tell them we have made the goal and are now on our way back. They will stop some miles short of the goal; as our average speed for the journey back will be higher than theirs, and if we do succeed in getting back to base we do not want to have to wait hours for them to return. Do not broadcast the letters we have seen.

Somehow we must beat old Chris back home. With any luck this thermal we are in will take us up into cloud, and as the wind is now behind us it will probably help us more the higher we get. Chris is way ahead and so will

not be joining us this time, but there must be other gliders in the vicinity which we have not seen, so keep a good look out. If we do get into the cumulus, shut your little windows as it can get very cold high up in cloud, and try to pinpoint our position just before losing sight of the ground.

We are very close now, and I have switched on my electric turn and slip indicator. Four thousand nine hundred feet and the earth is vanishing in a milky haze. Now we are right in cloud with the variometer showing nearly fifteen feet per second up. The glider seems to sound muffled and the air is cold and clammy. In cloud I try to fly steady circles at about rate one and a half on the indicator. This gives me a circle of about thirty seconds duration and about two hundred yards in diameter at 45 m.p.h.

Quite often the lift in cloud is rough, but we are climbing fast and so will not be in it for more than about five minutes, as the cumulus are not very big today. Big clouds are a very dark grey inside, and this one is getting much lighter above already. We are at five thousand eight hundred feet, and must be very near the top. Yes, here it is; six thousand feet and in the clear. When you come out of the cloud, the sky seems such a very deep blue and the other clouds dazzling in their brightness. The magnificence of the scene is worth all the grey turbulence of the interior. The ground looks very far below, and a soft greeny grey, with the sun sparkling on that winding river.

But we must not waste time looking at the view, so on to our homeward course, and increase speed to 65 m.p.h. which, plus the tail wind at this height, means that our ground speed should be just over 100 m.p.h.

There is an area of clear sky just ahead, and then some good cumulus which we will make for as fast as we can.

No sign of other gliders? It is great fun flying close to the clouds, we seem to be moving so much faster than we really are. Is there another sandwich to spare, before I have to start working the next thermal?

The cumulus ahead are beginning to look rather dilapidated. I hope they will still have some lift left underneath them, as the whole sky is no longer as good as it was earlier. If you look up you will see some very high cloud and this may be cutting off some of the sun's heat from the ground.

Yes, there is some lift left underneath these clouds, but not much. However, it will have to do until we can spot something better ahead. As we are flying with the wind now, it will drift us towards base all the time as long as we can just manage to stay in the air, but as we are racing, and every second counts, we must try to find something better.

Look away to our left, there is Chris again, and he is doing better than we are. Let's move over and help use his thermal. He is above us once more, but we should be able to catch him up with our better thermalling performance, although he certainly seems to have the legs on us when it comes to flying straight.

Contact the crew and tell them twelve miles short of home on course, but sky ahead looking pretty dead, and tell them not to return to base as we may well not have enough height left to get back to the top of the hill again, and may have to land in the valley.

This thermal is very weak, only two feet per second up, but there is nothing obvious ahead to go for, so we will just have to stay in it and just keep going slowly. We still have two thousand five hundred feet, but we must save some of that in order to make some sort of approach to land. As you can imagine, it would be stupid

to arrive level with the hill top, and then have to fly back down into the valley again to land.

We could risk making a dash for home from here, taking the chance that we might pick up some lift on the way. But if we find nothing, we fail to complete the course and get no speed marks at all, although we will get a few for the distance we have flown. I think our only hope is to struggle on in this wretched lift, which is really little more than no sink, until we have drifted a few miles closer.

Look, Chris has decided to make a dash for it. He is flying fast straight for the hill top. It is still eight miles away, but that glider has a fine high speed performance. He should be all right unless he encounters some unexpected sink. I think we will wait until we are two miles closer before we risk it.

Can you see those two gliders in that big grass field below us now? Their trailers are there and lots of onlookers. And away to our left there is another glider. It seems as though quite a few have failed to get back, so all the more reason for us to be cautious now. I cannot see Chris any more, but I think we can run for it now ourselves, so here goes. Straight for the hill, speed not too fast. It is easy to be impatient and increase speed to the extent that the actual performance of the glider deteriorates. Hold your breath. I think we can just make it. I can see the hangar now, and some gliders on the ground, and a crowd of people on that hillock watching for the gliders to return. I wonder if they have spotted us yet. Contact the crew and tell them we've made it—I hope!

Look, there is Chris. He is well below us and circling. He can never make it from that height unless he gets up again and then we shall have beaten him on time.

Careful now, fly as accurately as possible. We are nearly home, but there is a glider on our left, I can just see him out of the corner of my eye. He is yellow, and gaining on us. He must be diving at 100 m.p.h., but I am sure he started before us, unless he went back and had another start to try to make better time. He is over the field now and pulling up in a steep turn before going in to land. We can go faster too now, we have not lost as much height as I thought, and we should clear those trees with about three hundred feet in hand. 80 m.p.h. and we are over the field, pull up to reduce speed, turn into wind, brakes out, and we are home. One hour thirty minutes for the return trip, and four hours ten minutes for the whole flight.

Let's park the glider now, and go up on that little hillock and watch the other gliders come diving home. Eleven have failed to get back, nine have returned here and there are three still airborne. Somewhere in that hazy sky there are three pilots hanging on to every inch of height, searching for invisible lift with only the gentle whistle of the glider to break the silence. They have nothing to help them except their own skill and their own determination. Look! Here comes one of them now, like a tiny bird in the distance, with the sun glinting on his cockpit cover. It is the Blue Olympia, and its pilot was seventeen yesterday.

The soaring pilot's badge.
Silver and Gold.

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