

DEREK PIGGOTT ON
GLIDING



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Beginning Gliding: The Fundamentals of Soaring Flight

Gliding: A Handbook on Soaring Flight

Going Solo: A Complete Guide to Soaring

Understanding Gliding: The Principles of Soaring Flight

Understanding Flying Weather

To Wally

With best wishes

Derek Pym

10th Aug 2002

DEREK PIGGOTT ON
GLIDING

A & C Black · London

First published 1990 by
A & C Black (Publishers) Limited
35 Bedford Row, London WC1R 4JH

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ISBN 0 7136 5799 5

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A CIP catalogue record for this book is available from the British Library.

Printed in Great Britain by
Hollen Street Press Ltd, Slough, Berkshire

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Acknowledgements

I would like to thank Maria Boyd for the original suggestion for this book and for all the help and encouragement she gave me.

Chapters 2–11, 13, 14 and 16 were first published in the British Gliding Association magazine *Sailplane and Gliding*.

Chapter 12 was first published in *The British Soaring Handbook*.

I would like to thank all the editors of these magazines for their help and permission to republish these articles.

Preface

This book brings together material which I think will be useful to instructors and to those gliding enthusiasts who have taken up gliding more recently.

Much of the text is also relevant to flying ultra light aircraft such as the three axis microlights (including Shadow, Thruster, Chevron and so on). Because of their relatively low flying speeds the handling characteristics of these aircraft are usually similar to those of gliders and motor gliders. Moreover, like glider pilots, their pilots must be aware of the effects of turbulence and sinking air.

Throughout the book glider pilots are referred to individually as 'he'. This should, of course, be taken to mean 'he or she' where appropriate.

Units

In most other fields the metric system is used for distances, speeds and weights. However, this is by no means the rule in English speaking gliding circles. Wing spans are always referred to in metres while distances, height gains and speeds for badge and record flights are always referred to in kilometres, metres and kilometres per hour. Rates of climb and flying speeds are usually referred to in knots or nautical miles per hour and most altimeters are calibrated in feet.

It is often useful to know the average achieved rate of climb by timing the gain of height over a period of one or two minutes to obtain the rate of climb in knots or hundreds of feet per minute. As a nautical mile is 6,080 feet, a knot is, for practical purposes, 100 feet per minute.

If flying with an airspeed of 60 knots and the rate of sink indicated is 4 knots, the gliding angle is easy to calculate: $60/4 = 15:1$ (in no wind conditions). To make a similar calculation using an airspeed of 110 k.p.h. and sink of 2 metres per second involves converting both to a common time base, say minutes. This is certainly beyond the average pilot in flight without a pocket calculator.

A further advantage is that one minute of latitude always equals one nautical mile, making it easy to measure the distances without having to unfold the map to refer to the normal distance scale.

Introduction

A history of gliding

People have been thinking about ways of flying for thousands of years. The Chinese had their kites but as far as is known kite flying did not progress beyond lifting people for fun and, in time of war, for observation purposes.

Sir George Cayley is now recognised for his work in designing and developing practical gliders. He was the first person to realise that there was no future in having flapping wings like the birds. In 1799 he saw that the wings had to be rigid and the propulsion achieved separately and not by flapping the wings themselves.

Certainly he seems to have established most if not all the essentials necessary for successful flight. He understood streamlining, the need for cambered aerofoils, the need for a proper tail and fin for stability and the use of dihedral on the wings for lateral stability. His model glider designs have proved to be excellent, stable flying machines, and no one seriously doubts that he did indeed put his coachman on a glider to fly a short distance some fifty years before the Wright brothers.

Next came a series of fliers, among them Lilienthal and Pitcher, who developed what are now called hang gliders. Control was achieved mainly by weight shift, and flights of up to a minute became possible.

The Wright brothers then took up the challenge of the conquest of the air and they recognised the need to learn to fly before attempting to build a powered aircraft. Over a period of several years they taught themselves to fly their gliders, developing their machines until they were controllable. By flying in front of a slope in a strong wind they were able to soar for a few seconds and to develop the expertise necessary to fly powered machines at a later date. By that time, petrol engines had been developed and a light enough engine could be made to power the Wright brothers' powered aircraft.

When the 1914-18 war came the development of the practical aeroplane proceeded very rapidly. There was little or no call for gliders during the war, but the Treaty of Versailles, which specifically prohibited the Germans from building and flying powered aircraft, sparked off the idea of their flying gliders instead.

The 1920s saw a very rapid development of glider design, particularly in Germany. At first even a few minutes' flight was a triumph, but soon the records stood at several hours and distance flying had also begun. Using the lift created by the wind blowing up the slopes of hills, and later with the lift under shower clouds, it was not long before flights of

hundreds of kilometres were being achieved, not for commercial or military reasons but because it was fun to fly and explore the atmosphere.

Again a war intervened, but this time troop-carrying gliders played their part and in Germany the sporting gliders were used for the basic training of pilots for the German Air Force. In this way a certain amount of glider development continued and many people were introduced to the sport of soaring.

With the return of peace, glider manufacture restarted and gliding clubs re-formed all over the world. Prior to about 1950 almost all glider training was by the solo method. With this students literally taught themselves to fly, starting with ground slides where all they had to do was try to keep straight and hold the wings level on a very crude open frame Primary glider. Later they would progress to low hops and then high hops where the student was launched by car or winch to about 200 feet before gliding down to a landing straight ahead. The flights were measured in seconds and a solo hop of thirty seconds entitled the pilot to the coveted 'A' gliding certificate and badge. Longer flights were usually made by using hill lift although thermals were understood and used by the more experienced pilots.

By 1950 it had generally been recognised that training in dual control two-seater gliders was far more efficient and safe. Well designed two-seater trainers became available all over the world and training by the solo method ceased.

Both the glider pilots and the gliders themselves improved in performance, making much longer flights possible. Wartime developments such as the low drag aerofoils used on the Mustang fighter and other more modern machines attracted the attention of the glider designers. Once adopted, the so-called laminar flow aerofoils resulted in a leap in performance particularly at the faster gliding speeds, making cross-country flying against quite strong winds a possibility. The stiffer wings resulting from the smoother, thick skins necessary for these wing sections also gave an improvement in the lateral control. On many of the earlier designs the wings had obviously been twisting as the ailerons were applied to roll the glider with the result that the aileron effectiveness was diminished.

Today the state of the art is that we have both single and two-seater gliders with gliding angles approaching sixty to one, capable of flights of over 1,000 kilometres (620 miles) at average speeds of nearly 150 k.p.h. (90 m.p.h.). The gliders themselves are almost all made of glass and carbon fibre composites, are simple and safe to fly and incredibly strong. Unfortunately, they are also very expensive to make and buy.

Gliding awards

Without a doubt the progress gliding has made has been greatly influenced by the system of national and international awards. These are

recognised throughout the world and set standards of achievement for every glider pilot. At each stage of the pilot's experience there is always another test of skill just within reach.

There are no gliding licences in the UK and the standards are set and maintained by the British Gliding Association. A medical certificate is not required but each pilot has to sign a declaration that he does not suffer from any illness which might make him unfit to fly. In most other countries licences and medical examinations are required.

National awards

The 'A', 'B' and Bronze 'C'

The 'A' and 'B' certificate awards are awarded for the first solo flight and the first soaring flight. Each country has slightly different requirements.

In the UK, and more recently in the USA, there is a Bronze 'C' badge. The requirements for the British Gliding Association Bronze 'C' include a written ground examination on the principles of flight, airmanship, simple meteorology and air law, two soaring flights of a minimum of thirty minutes from a winch or car launch, or one hour from a 2,000-foot aerotow, fifty solo flights and a flying test by a senior instructor. This test includes a simulated field landing or some training in selecting and approaches into fields in a motor glider. Most beginners obtain their Bronze 'C' during their first few months of solo flying.

Fédération Aéronautique Internationale

Silver 'C'

The Silver 'C' badge has three tests or legs.

1. Duration. A soaring flight of over five hours.
2. Gain of height. A gain of height from the lowest point after a release of 1,000 metres (3,281 feet).
3. Distance. A flight of over 50 kilometres (31 miles). This can be done in a variety of ways but in all the loss of height from release to the point of landing or the declared finish point must not exceed one per cent of the total distance.

Whereas in the 1950s the Silver 'C' was considered a very high standard and quite difficult to obtain, in a modern glider the requirements can now be achieved on a single flight. In good conditions the distance flight can be made following a single high climb after release. However, the

badge still represents a considerable achievement and gives the pilot status and a substantial reduction in the flying requirement for a Private Pilots' Power Licence.

Gold 'C'

The Gold 'C' badge award also has three legs.

1. A duration flight of over 5 hours. (In most cases the pilot has done this already for the Silver 'C'.)
2. A gain of height of 3,000 metres (9,843 feet).
3. A distance flight of 300 kilometres (186 miles).

Diamond 'C'

There are three diamond awards.

1. The diamond height. A gain of height of 5,000 metres (16,404 feet).
2. The diamond for a declared flight of over 300 kilometres (186 miles). (Only an out and return or triangular course declared prior to take-off.)
3. The diamond distance flight. A flight of over 500 kilometres (311 miles). This can be a flight round up to three different turning points declared before take-off, or a straight distance. (The exact requirements are laid down by the FAI and are somewhat complex.)

More recently flights of over 1,000 kilometres (620 miles) have become relatively common in countries where the soaring conditions are better than in the UK. This has led to the FAI awarding diplomas for both 750 and 1,000 kilometre (465 and 620 mile) flights. To date there have been a few flights of over 750 kilometres in England but none of 1,000 kilometres.

Of course all these flights have to be correctly documented, using a barograph to record the heights and progress of the flight, and photographic evidence to prove that the glider has reached and turned the previously declared turning points correctly.

The badge system has given glider pilots targets to aim for throughout their early and their later flying. In effect the longer tasks are a race or competition against the elements. The soaring conditions normally depend on the effects of the sun's heat and last a maximum of eight or nine hours in the summer-time.

Gliding competitions have played the most important part in the improvement in glider design and flying techniques. They attract both the non-technical pilot and the person who is interested in the decision-making which is involved in flying over long distances and at high speeds. Most competitions consist of a series of races around predetermined turning points so that all the competitors are attempting the same task. Winners of the National Championships are selected to fly in the

World Championships which are held every other year in a different country each time.

Learning to fly gliders

There are gliding clubs and schools in almost every country in the world where a beginner can learn to fly. The first thing to do if you are thinking of taking up the sport is to find where your nearest gliding club or school is located. Ask any gliding enthusiast or, failing all else, contact your National Gliding Association. (*See Useful Addresses page 157.*)

It is usually possible to arrange for a trial flight or introductory lesson to see if you really enjoy it. If there are several clubs within reach, I would suggest visiting them all to see which offers the best opportunities for you. A small 'weekend' club is unlikely to have the facilities of a larger, full-time operation but may be more personal and fun to fly with. If you are able to fly on weekdays, the airfield is bound to be less congested than at weekends, and this will make it easier for early training.

Courses

Many of the larger clubs run residential courses and these provide better continuity than is possible flying on a 'casual' basis. Statistics prove conclusively that, if you can afford it, formal courses are more efficient and, in the end, less costly than flying now and again with a different instructor each time. If you do decide to start with a course it is worth while trying to get one or two flights beforehand to acclimatise. Many students start their course with virtually no experience and find it difficult to get relaxed until the week is nearly over.

It is impossible to state exactly how long it takes to learn to reach solo standard. However, it is true to say that beyond 30, the older you are the more experience it will take. For most pilots it takes 2 or 3 weeks of continuous training or about 6–8 hours and 50–60 flights. This can easily run up to 80–90 flights if you fly on an occasional basis because you soon forget and get out of practice.

Usually you fly with your instructor to practise every conceivable emergency until you are both confident of your ability to fly safely. As well as stalling and spinning, launch failures and cable break procedures, every aspect of flying will be covered. It is usual to make the first solo flights in the two-seater glider that you are training on, and for dual training to continue with daily check flights, until you have ten to twenty solo flights behind you.

Incidentally, modern two-seater gliders are capable of good soaring performances, and by the time you are ready to solo it is normal for you to have learned how to use thermals. Even on your first solo flights you may be able to stay up for half an hour in good conditions.

Private ownership

Until they have reached about Bronze 'C' standard the vast majority of pilots use club single-seater gliders. This means being at the field early on any promising soaring day in order to get your name near the top of the flying list. Usually the order of the list is the order for flying, so first come, first to fly. This is reasonably satisfactory for the pilot who is building up experience during the winter months, but for the enthusiast who wants to be able to stay up most of the day, it is very frustrating to be at the bottom of the flying list and to find all the club machines up soaring. It is a great advantage to own a share in a glider so that you can fly more and do not have to bother with the flying list system.

Most gliders are owned by syndicates of up to six pilots with proper agreements as to how the glider is shared between the members. Gliders do not depreciate much in value and used gliders are often changing hands as their owners get the urge to move on to machines with a higher performance. The maintenance is minimal and the major cost is the insurance. Most pilots insure their gliders comprehensively, although they are only legally liable to insure for third party risks. Owning a share in a glider is essential if you are ambitious and want to progress quickly.

Is it for you?

Unfortunately gliding is not one of those sports which you can do on an occasional basis. It is essential to practise constantly if you are to fly safely and efficiently. Moreover, it is not an individual sport as it requires team-work to get up in the air. Just to get launched requires a team effort with at least three or four other enthusiasts helping. You need a winch driver or tow pilot, a wing runner and signaller and, except in a commercial gliding school such as exist in the USA, you rely on fellow members and not on paid staff.

To go gliding you really need to set aside the whole day so that you can help others as well as fly yourself. If this puts you off the idea, I'm pleased to have saved you time and money. Most gliding enthusiasts find that they enjoy all the activities and not just the flying. Gliding is for them a way of life.

I The learning process

While you are learning to glide you are in the midst of a host of problems and difficulties. It is only too easy for an instructor or an experienced pilot to dismiss your anxieties with a comment such as 'Oh, you will soon get the idea – it's just a matter of experience'. Whereas this can be true, it is much quicker and easier to tackle each difficulty by understanding why it happens and how to overcome it rather than to carry on hoping it will all come right in the end.

If you are well on the way to solo you will almost certainly have forgotten the horrible sensations that you experienced on your early flights. When you are just starting to learn you will find these sensations most disconcerting if not alarming. At first they will often prevent you from thinking clearly and controlling the glider properly. But remember that they are quite normal and should disappear gradually as your eyes and other senses get used to flying and are able to tell you what is going on.

Co-ordination – stick and rudder

Certainly the greatest problem is to control your feet so that you can make co-ordinated movements of the stick and rudder as you go into and out of turns. Because you have to form a habit and habits take time and experience to form, you cannot learn this co-ordination out of a book or in any other way except by practice. Remember that straight flight is going to be impossible at first until those movements are almost instinctive and automatic. So, don't get discouraged when you can't even fly straight. Your instructor will not be surprised or disappointed in you as everyone has this problem.

Length of practice sessions

You will also find that this co-ordination will get quite good on one day and then degenerate the next. This happens for a variety of reasons. If you fly for more than about twenty minutes practising turns, you will find them getting worse as you lose concentration. For most beginners, two or three five-minute winch launch flights or one aerotow of about twenty minutes is about the limit for making progress, and then it is best to stop and have a break before doing any more. You will soon

realise that in the early stages, long soaring flights do not get you much further towards solo, nor do they teach you much about soaring techniques. Thirty minutes of working hard is worth more than an hour or more when you are getting tired.

Some common problems

The approach

You will often find that your turns go well when you are up flying high but deteriorate as you get lower and begin to think about the approach. As soon as you are flying down towards the landing area the glider seems possessed with the devil and starts to yaw all over the place. Don't despair, this is quite normal. It just means that your co-ordination has not yet reached the automatic stage and that when you start to think about the approach and landing you are forgetting to use the rudder. Each time you make a little sideways movement on the stick to get the wings level, that aileron drag swings the nose off to one side. Don't worry. In a few more flights' time the problem will cure itself and all will be well.

Confidence

You may even find it difficult to get the glider to fly where you want on the circuit. Once again the cause is too much to think about so that the rudder movements get forgotten.

Ultimately, it is important to understand what is making the glider behave as it does, particularly with respect to stalling and spinning. Don't be afraid to ask questions if you don't understand something. It can all be explained in simple terms and you ought to be apprehensive about things until you understand how and why they are happening. Even then you need experience and practice to gain confidence in your ability to deal with any situation which might arise. Confidence without understanding can be very dangerous in all forms of flying.

Landings

Landings always seem much more difficult than they really are because each one is different. Once you understand what you are trying to do you begin to have a chance of learning how, but any misunderstanding guarantees that problems will arise. If you are already having difficulty, look at a copy of my book *Beginning Gliding* which has a very comprehensive section on how to learn to land.

Airbraking

Things often begin to go wrong when you start to use the airbrakes, and your progress may be held up. Until then you will probably only have had problems with co-ordination. Suddenly you are expected to use judgements which seem vague and undefinable. Once again a better

understanding will be a great help. Get your instructor to explain how to judge the circuit and approach.

Following the towplane

You are almost certain to find that following the towplane on aerotow gives you problems at first. Do not despair. It is just a knack which comes suddenly after a certain amount of practice. I have never known anyone who could not learn to do it, so I am sure you will not be an exception.

Planning the approach

When it comes to planning and judgement, remember that it is much easier to get a good approach if you have a reasonably long base leg. This gives you more time to think and adjust your positioning for the final turn. It is a mistake to try to arrive with a minimum of height for the base leg and final turn as this seldom leaves you enough time or room to make adjustments.

You must learn to give yourself enough time to monitor the airspeed, adjust the positioning and height, and open the airbrakes and adjust their setting on the approach. To do this you have to think ahead of the action or you will be so short of time that you will have to make whatever approach you can from the position that the glider has put you into. There are numerous ways in which you can make the planning more difficult for yourself, and consistently being slightly short of height in the pattern is one of the obvious ones.

The same applies for launch failures and other emergencies. You often get an incomplete briefing out on the airfield and some of the things which can and do occasionally happen are very serious unless you know about them beforehand.

Learning anything new is always interesting and learning to fly is a great challenge for most people. The following chapters are designed to help both beginners and instructors to grasp the essentials more quickly.

They do not include all aspects of gliding; for example winch launching and stalling and spinning have been omitted as they are well covered elsewhere and are best introduced by the instructor.

2 First flights

One of the biggest difficulties in learning to glide is convincing yourself that you are, in fact, making satisfactory progress. To do this you must understand a little about the learning process, and this is not often explained by the instructor. It is an unfortunate fact that many quite important aspects of glider training do not always get covered by every instructor. The misunderstandings which arise create problems for everyone and I am hoping that this book will be of help to both students and instructors.

Sensations on your first flight

Few pilots or instructors spare enough time to explain the sensations a beginner usually experiences on the first few flights. At this stage it is quite normal to have worrying if not rather frightening feelings, and many would-be pilots dislike them so much that they give up after one or two flights. A few words of comfort and explanation would be invaluable to most people having their first glider ride.

There are several reasons for these sensations. Our sense of balance is normally directly related to gravity and we are not familiar with movements and accelerations in all three dimensions. Once in the air, therefore, we begin to experience worrying sensations but are unable to relate them to the movements of the aircraft. Such sensations are normally suppressed by our brain when our eyesight recognises exactly what is happening. But this only comes with the experience of a number of flights.

Also, at this stage it is quite normal and only natural to be rather nervous about handling the controls, and this uncertainty adds to our worries. Flying on a turbulent day, and particularly when there is no clear horizon, makes these sensations far worse. There is no way of telling when the bumps will occur and it is more difficult to recognise what is happening to the aircraft as it is tipped or jolted about. When handling the controls in these conditions every bump gives the impression that the aircraft is about to fall out of the sky, and only constant reassurance by the instructor will help a nervous person to enjoy the flight.

We are particularly sensitive at first to the feeling of 'lightness', which occurs as we lower the nose of the glider. This low 'g' or reduced 'g' sensation is similar to the feeling of falling we experience in a nightmare,

so we tend to associate it with falling. On an early flight the feeling is alarming because the possibility of falling out of the glider seems very real. After a few more flights your brain anticipates the feeling as you move the stick forward and see the nose actually dropping in relation to the horizon. The same sensation can occur flying through turbulence. In this case we learn to identify the cause and after a number of flights the bumps, although disturbing, cease to alarm us.

Conditions for first flights

The importance of selecting reasonably smooth conditions for your first few flights is obvious. These sensations may continue to be worrying until you have confidence in the use of the controls. Until then it will be frightening to find that the glider is not responding or is momentarily tipping the other way as it is bumped. On a very hazy day it is much more difficult to see what is happening, making the sensations worse and reducing your confidence in what you are doing.

In practice the weather is never perfect, but it is helpful to realise that turbulence and poor visibility are bound to have a big influence on your flying ability and confidence in the early stages. These are very significant problems if you are a beginner, and pilots and instructors concerned with early training flights should, therefore, explain them to avoid prolonged circling, stalling or any abrupt manoeuvres.

Learning the controls

The first real lesson in flying is to find out the effects of controls. You will soon get the hang of the stick movements. If you move the stick forward the nose goes down, while if you move it backwards the nose goes up. Moving the stick a little to the left causes the glider to tip or bank to the left and also to begin to turn. The easy way to remember the sideways stick movements is that you move the stick towards the wing you want to push down, that is you push the wing down with the stick.

But whereas the stick movements are logical and soon become almost instinctive and automatic, no one finds the rudder movements easy or natural. Those rudder movements certainly are the devil to get right! Not only is it a matter of getting the correct direction and amount of movement, but they have got to become almost totally automatic. This is further complicated by the variations in the rudder forces which can occur when your co-ordination is poor. On many types of training gliders, particularly the K7, K13 and Bocian, the rudder tends to 'over-balance' whenever the turns are inaccurate.

Imagine yourself as a beginner trying to learn to turn. Unwittingly

you fail to apply quite enough left rudder as you bank over into a turn to the left. Something odd seems to happen and you get a vivid feeling as though the glider is rolling right over and you are going to fall out. Then you feel the rudder pedals move as if the instructor is on the controls. 'Damn it' you think. 'Why can't he leave me alone'. It all becomes even more confusing when you realise that it feels as though he is pushing on the right rudder pedal but he is telling you to apply more left rudder.

This is very confusing until some time later you realise that most of the time your instructor was not even touching the pedals and that it wasn't him but the airflow which was moving the rudder and accentuating your original small error. The reason for this problem is that the rudder on most gliders does not centralise itself. Every time that the aircraft is banked into or out of a turn without the correct amount of rudder, it flies slightly sideways for a few seconds. As this happens the airflow pushes sideways on the rudder surface, moving it further across the wrong way. If you feel the rudder moving or trying to move against your feet it may not be the instructor riding the controls at all. Imagine, if you like, that you have a lunatic sitting in the back cockpit. Every time you get the rudder movement wrong he insists on making your error worse by kicking on the wrong rudder even more. For example if you apply too much rudder or keep it on during the turn instead of reducing it to just a small amount, the aircraft will skid badly and the rudder will overbalance and lock on requiring some force to reduce the deflection or to re-centralise it.

If you experiment and apply full rudder slowly you will notice how to begin with it takes more and more force to apply. Then, quite suddenly the force required drops or even reverses so that the full rudder will stay on by itself. A further confusion often arises. At the same time as the rudder overbalances, the needle of the Air Speed Indicator (ASI) swings back through the zero mark to give an entirely false reading. If you happen to be glancing at it at that moment you may well be deluded into thinking that you are about to stall. Even a small amount of slip or skid will cause the ASI to under-read.

If you do feel this movement of the rudder pedals as though your instructor is riding the controls, ask him. He should be able to tell when the rudder overbalances by watching your turns, and ideally he should tell you when his feet are off the pedals and that the movement you experience is the air moving the rudder and not him.

This characteristic is unacceptable in a normal powered aircraft. It is really caused by a lack of directional stability, that is when the fin is too small. It causes endless confusion to beginners but is scarcely ever noticed by the experienced glider pilot. As a result the effect is often forgotten by instructors or at least not demonstrated in a convincing manner. Get your instructor to show you or try it for yourself.

Make no mistake, this co-ordination of the stick and rudder is the main difficulty in learning to fly gliders. The trouble is that it has to become a habit and almost totally automatic. This takes practice – turns,

turns, and more turns. Note also that you will not be able to fly straight until these movements are correct. For example if a wing drops the glider will start to turn immediately. If you bring the wings level with the stick alone, forgetting the rudder, the adverse yaw will swing you even further off your original heading. To fly straight your correction for a wing dropping has to be immediate and accurately done by co-ordinating the stick and rudder together. Every time that you make a sideways movement on the stick and forget the rudder, the glider will start to swing from side to side.

Do not despair if you cannot do this after a few lessons. Flying straight will probably be one of the last things that you will learn before going solo. You will not be alone in finding this apparently simple exercise difficult.

The attitude

Most glider flying is done by attitude rather than by constantly referring to the ASI. This entails checking the position of the nose in relation to the horizon in order to maintain safe flying speeds. If the nose is in the correct attitude the glider will be cruising efficiently with easy handling. However, if the nose is a little too high the speed will be insufficient to give good control and the rate of descent will be high, while if the nose is too low the glider will be diving at a great speed, losing height rapidly.

After looking around before starting a turn, it is best to look ahead to re-check that the position of the nose is correct. This ensures that any changes in attitude can be spotted immediately. Do not watch the wing-tip.

When there is no horizon the pilot must guess the attitude and refer to the ASI more frequently to check that the speed is correct. However, overconcentrating on the ASI results in flying alternately too slow and too fast, because of the time taken for the aircraft to change speed after a change in attitude. This is known as 'chasing' the airspeed.

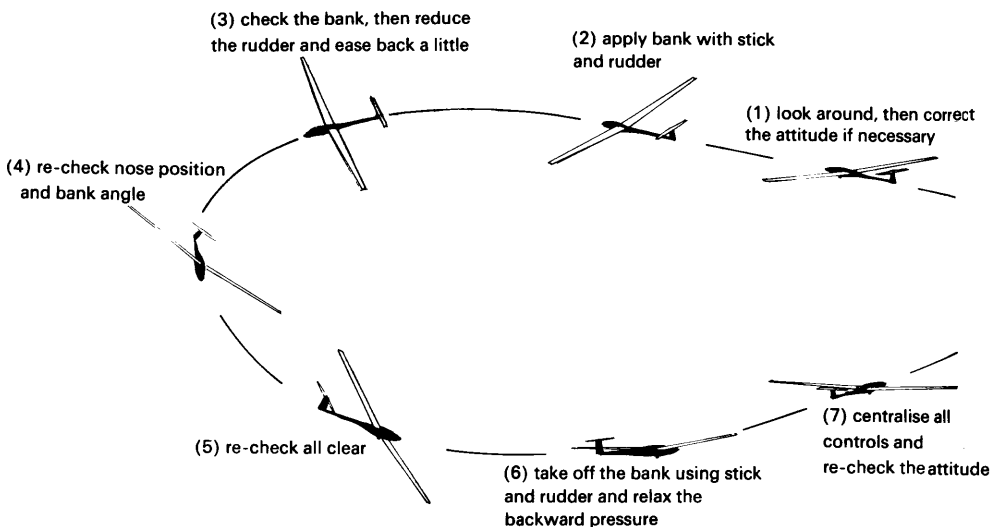
3 Turns

Co-ordinating control movements

Once you have seen how each control works, you are confronted with the problem of learning to co-ordinate the stick and rudder to produce accurate turns. Although it might seem that the two controls could be coupled together to work automatically for the movements required, their position in a steady turn with the stick pointing slightly one way and the rudder in the other makes this impractical. So the pilot has to learn a more complicated sequence which takes time and practice to establish.

However, the sequence can be considered as a pattern of movements and learned as such. With the exception of a few vintage machines which may have rather odd handling, the control movements follow a standard pattern. In fact it is often easiest for the instructor to dictate the movements to help to establish them, saying something like the following:

'First look right round and behind, then look ahead. Now stick and rudder together to apply the bank; check (or stop) the bank with the stick



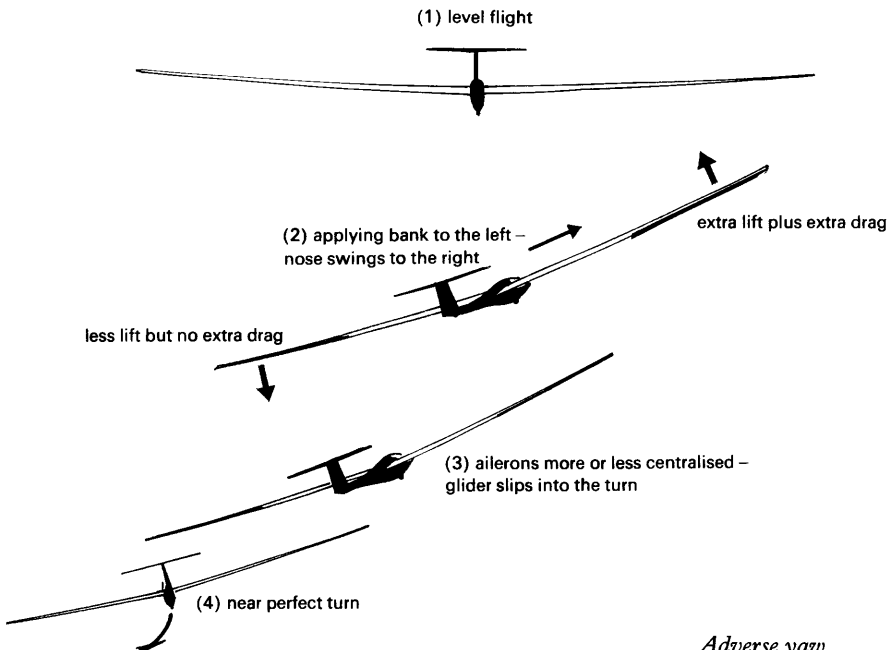
How to turn.

and then reduce the rudder; ease back slightly to prevent the nose from dropping; re-check it's still all clear. Coming out of the turn, stick and rudder together and relax the backward pressure on the stick; centralise the stick and rudder together as the wings come level'.

The vital thing is to ensure that the basic movements are correct. Practising the wrong movements will form bad habits which will be very difficult to rectify at a later date. Unfortunately, most gliders will make quite reasonable turns even though some serious faults are being made, and this makes the instructor's task a difficult one. For example it is possible to enter a turn gradually with no aileron movement at all yet without any detectable error. Also, it is almost impossible to spot any skidding in a turn even though the amount of rudder used has not been reduced, especially after a good entry using the stick and rudder correctly. Bad faults like this soon become habits and often are the cause of appallingly bad turns on to the final approach when the bank is applied quickly or a steeper turn becomes necessary.

The rudder

The reason for all this rudder work is simple. As the bank is applied, the rising wing is dragged back so that the nose is swung off and up in the opposite direction to the bank. This occurs because the wing which



Adverse yaw.

provides more lift also creates more drag. Whenever the angle of bank is changed by making one wing develop more lift than the other, the extra drag causes a tendency to swing. This 'yawing' movement only lasts a few seconds but prevents a smooth entry into the turn. The 'adverse yaw' as it is called is exaggerated by the big wing span and low flying speed, making it vital to use the stick and rudder together when applying or taking off the bank. Once in the turn this effect is almost eliminated so that the amount of rudder required is very small.

It takes quite a lot of practice to learn to use the correct amount of rudder, particularly if there is a change of rudder loads or if the airflow moves the rudder in the opposite direction. Trying to 'feel' the amount by following through on the controls as your instructor demonstrates a turn is not much help because it is difficult to sense the amount of rudder being used by feel, and, of course, because while the instructor is on the controls you can get no idea of the force he is having to apply to move it by that amount.

Some common faults with beginners

The following are some suggestions as to what you may be doing wrong if you find that you are never using the rudder correctly. When your feet and leg muscles get very tense, as they do on these early flights, you will tend to push with one foot without remembering to relax and withdraw the other one. When you do this, all you do is stretch the cables without moving the rudder. A few moments of moving the rudder, first one way and then the other, using quite large movements but without worrying about what the glider is doing, will help you to relax and make real movements when you want them.

You may find that you tend to under-rudder more to the right than to the left. This is likely if you are a car driver as your right foot is conditioned to the delicate touch needed for the accelerator. If you fail to use enough rudder going into a turn to the right but still reduce the amount of rudder by a normal amount once the turn is established, you will end up in a right-hand turn with some left rudder. Although not dangerous, this fault creates a very worrying sensation as though the glider is rolling right over and is about to fall out of the sky. The turn ends up side-slipping badly with the wrong rudder still being applied. Watch for this tendency to under-rudder to the right and remind yourself to use enough.

The other helpful thing is to watch the actual control movements as your instructor demonstrates a turn. Hopefully he will make the moves slowly and deliberately and describe them in the process:

'I'll look around this time. Watch the stick and rudder movements and try to memorise how much they move and how I move them. Stick and rudder together – see the amount of rudder. Checking the banking movement with the stick to keep it constant, I then reduce the rudder. See the small amount I leave on for the turn. Now I'm using a small

backward movement to prevent the nose from dropping. Coming out of the turn, I move the stick and the rudder exactly together as if I am going to change over to a turn in the other direction. Now as the wings are coming level, I move the stick and the rudder together to centralise the controls'.

The visual image formed by watching the actual movements helps enormously in overcoming the initial difficulties of getting the timing and the amount of the movements correct.

During the early flights most beginners have much the same problems with the use of the rudder. At first it is usually either a failure to use the rudder at all or to use it sufficiently. Later it is more likely to be more subtle faults which are difficult for the instructor to spot and analyse correctly. Often these faults go undetected and they soon become bad habits which are then even more difficult to eliminate. Strange as it may seem, the surest way to detect poor co-ordination habits is for the instructor to watch the control movements as these should follow an easily recognisable pattern.

A lot of problems can occur if all the stick and rudder movements are made simultaneously. The two controls should be moved exactly together as you apply the bank, as you take off the bank and as you centralise the controls to keep the wings level after coming out of a turn. However, it is important to make the stick movement just a little *before* reducing the rudder as the required angle of bank is established. The ailerons are used to roll the aircraft and must be used to stop the banking movement at the angle you want. The rudder must be used as you apply the bank to prevent the adverse yaw, but it does not control the banking. (Of course changing the position of the rudder does have some influence on banking movements because of the effects of dihedral and so on, making the glider tend to bank when the rudder is applied.)

Unfortunately the habit of reducing the rudder at the same moment as the ailerons are moved to stop the banking movement results in repeated side-slipping faults. It is exasperatingly difficult to re-learn the correct movement except by exaggerating the pause between checking the bank with the aileron and reducing the rudder. On balance I believe it is best to teach a definite and deliberate gap to establish the right kind of habit, knowing that with more experience and practice the gap will close. Above all it is most important that the amount of rudder is always reduced once the bank has been established.

Some common faults with power pilots

Power pilots converting to gliders will have almost as much difficulty as a beginner because their habits are already formed and are difficult to change. If asked to make a turn they usually start to apply the bank as they look around, only to find to their annoyance and amazement that on looking forward again the glider is in an unexpected nose-high attitude, slipping badly. Their problems are best solved by the instructor's

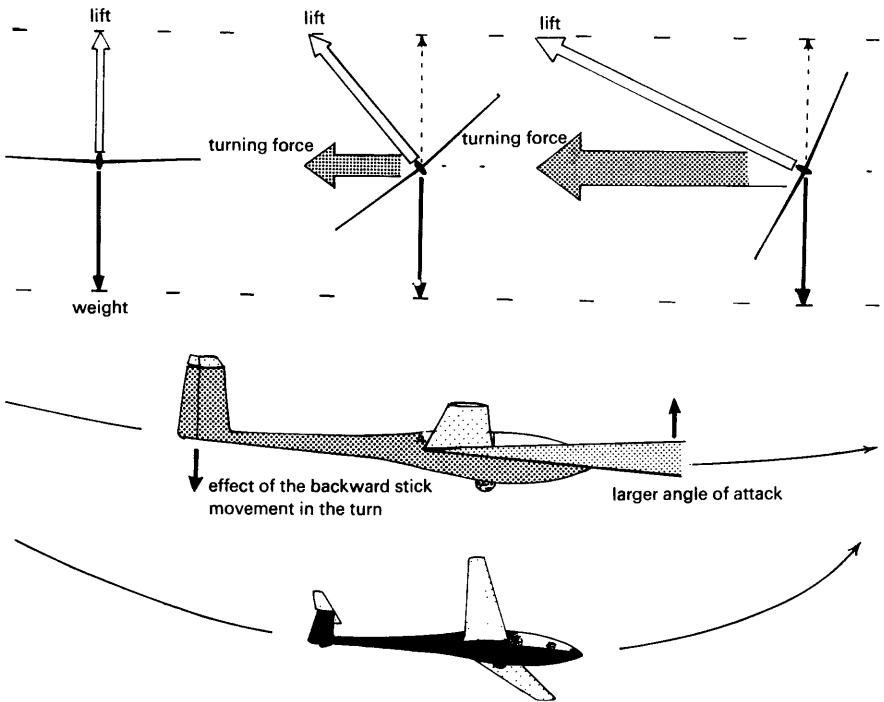
slowing them down to make them think about the moves instead of allowing them to happen automatically. He may tell them the following: 'Look around, but don't start the turn yet. Now look ahead. Think of the movements – stick and rudder together. Now go into the turn and don't watch the wing-tip.'

In the early stages it is probably a bad thing to attempt to use the yaw string or slip ball to detect or correct errors caused by the wrong amount of rudder. This is because the movements which should become automatic can easily become a series of corrections requiring constant attention from the pilot. In this respect the use of the rudder on a glider is different to that on a powered aircraft. In these machines the rudder is applied as a correction for the yaw which occurs after increasing or decreasing the power to climb or glide. But after the change of power the pilot can afford to wait and observe the resulting yaw before applying the necessary rudder to overcome it. A small amount of slip or skid is relatively unimportant and so it doesn't matter much if the power pilot takes time to detect and correct it. However, with a glider the use of the rudder during the entry to the turn must be automatic. Poor co-ordination makes it impossible to fly straight.

Handling characteristics

The light aeroplane pilot will soon realise that the large wing-span and low flying speed of the glider result in very different handling characteristics to other aircraft. Unlike a light aircraft the stick position in a turn is not central as there is always a tendency for the angle of bank to increase. This increase must be avoided by using the ailerons to 'hold off' the bank. At the same time a small amount of rudder is required in the direction of the turn. This is a 'crossed' control situation which in a normal aircraft would be a sign of over-ruddering.

The amount of hold-off required to keep a constant angle of bank is quite small unless an excess amount of rudder has been left on or unless the glider is flying too slowly and is close to stalling. Both causes can lead to trouble and therefore a large deflection of the aileron to hold off the bank should always be considered as a danger sign. Excess rudder results in skidding and very high drag as the fuselage moves sideways through the air. This acts as an airbrake and inevitably causes a loss of airspeed and a risk of stalling even though the nose has not been raised. There is also a tendency for the glider to overbank more at very low speeds so that a large stick deflection to hold off the bank can also be a warning of a dangerously low speed. In either case, lowering the nose should be the first action, followed by checking the amount of rudder being used and reducing it as necessary.



Easing back on the stick after banking over ensures greater turning force. This in turn pulls the wings to a slightly larger angle of attack, providing the required amount of extra lift.

Co-ordination practice

Once the correct movements are becoming established, it is useful to practise turning smoothly from one direction to the other. Some instructors try to get their students to 'roll' on a point, that is to bank from one side to the other without turning. Strictly speaking this should be impossible, since the glider is being kept straight while it is banked, an aerodynamic impossibility without some slipping movement. A far better exercise is to allow the glider to turn and to make some of the changes in bank quickly and others slowly. It is important to keep some of the turns going for long enough to ensure that the rudder is reduced once the turns are established.

Most gliders are extremely short of rudder power and directional stability. If all the aileron deflection is used to apply the bank very quickly even full rudder will not eliminate the adverse yaw. It is easier to limit the amount of aileron movement to half or three quarters of the

available stick movement so that an accurate turn can be made. Once in the turn very little rudder is needed, regardless of the type of aircraft or glider.

In any turn the force required to make the change in direction is obtained by banking over and using the lift from the wings to pull you round the turn. More lift is therefore required and this is obtained by easing back on the stick to pull the wings to a larger angle of attack. The amount of this backward movement is very small for a gentle turn and increases rapidly as the bank is increased beyond about 30° . Since centring in thermals depends on straightening up quickly and turning accurately at a low, controlled speed at varying angles of bank, the ability to apply the correct amount of backward pressure almost instinctively is necessary for efficient soaring. An accurate steep turn at a relatively low speed will often make it possible to use the very narrow cores of lift and so climb much faster.

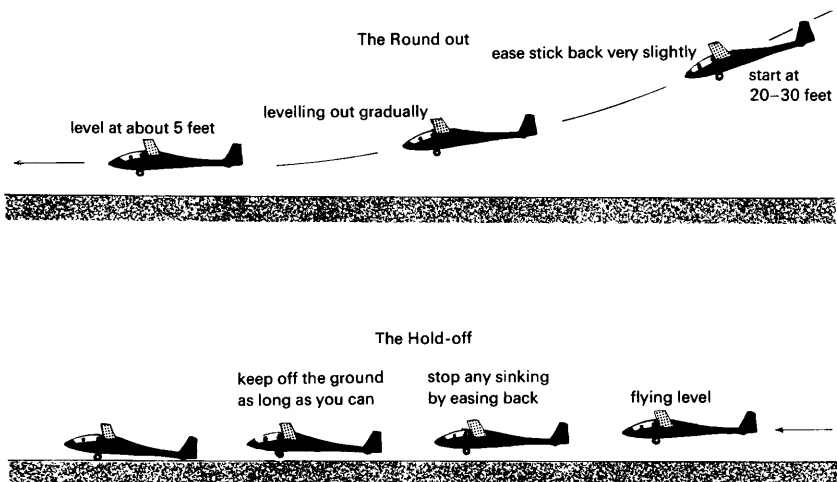
4 Landings

There is only one real problem about learning to land a glider – you only get one landing per flight. A single flight gives you just one go at making a satisfactory landing and very little, if any, hope of finding out whether that good landing was due to chance or skill. Ideally, you need a number of consecutive landings to make any real progress.

In order to make consistently safe landings you need to learn to recognise what is happening during the landing and to respond with the appropriate control movement. This cannot be done by learning the rate and size of the backward movement on the stick since this will be different for every landing.

Judgement

Difficulties usually arise because of a misconception about what you are supposed to do. For example if you are attempting to land on a particular spot you will always tend to fly the glider on to the ground instead of



Landing. Make a very tiny, gradual movement on the stick to start the round-out at about 20-30 feet. Then use a gentle backward movement to keep the glider just above the ground until it sinks slightly and lands.

trying to keep it off as long as possible. Similarly, if you are trying to judge the landing attitude you will inevitably fly on to the ground prematurely.

What you should be doing is to gradually level out from the approach so that you are flying more or less level, a few feet above the ground. (This is known as the 'flare out', 'round out', or 'initial check'.) Then you should attempt to keep the aircraft just a few feet above the ground, stopping it from sinking by gradually easing back on the stick. If the aircraft starts to gain height (known as 'ballooning') stop the backward movement, wait until you see that you are beginning to lose height and then ease back to continue the hold-off. Finally the glider will sink on to the ground in spite of your backward movement.

Ballooning

It is only after a few attempts that you become aware of the difficulties. Because of the increased flying speed used on the approach the elevator is extra sensitive so that the initial backward movement has to be very small, perhaps only 2mm (1/16in) or so. Most beginners overdo the initial movement on their first attempts. Unfortunately, as the glider balloons upwards a few feet they will respond instinctively by moving forward on the stick. This will usually result in a very rapid loss of height and a rather heavy premature landing. Hopefully your instructor will be ready for this and will be quick to stop you.

In order to land satisfactorily you will have to learn to overcome that instinct. Unless you balloon upwards twenty or thirty feet you will not have time to avoid flying into the ground if you move forward. Instead, you should hold your hand still, wait, and as you see you are starting to sink again, begin another gentle backward movement on the stick to stop the sink as the glider reaches a height of a few feet. For most people this is easier said than done. It seems almost automatic to make a forward movement, so you will have to unlearn this instinct. Only if the ballooning takes you very high or occurs towards the end of the hold-off is there any need to move forward momentarily. As long as the approach speed has been adequate, the ballooning movement is with the aircraft in an almost level attitude and there is no danger of stalling.

The float or hold-off

Whereas in normal flight the attitude of the aircraft is all-important, during the landing you should cease to worry about the attitude and instead concentrate on your height above the ground. Fortunately the designers of most gliders have set the wing on the fuselage at the correct angle to suit the undercarriage. If the pilot keeps the glider from sinking while flying a foot or two above the ground eventually it will sink and

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ISBN 0-7136-5799-5



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