THE MANUAL

for

Elementary Flying Instruction

in

TWO-SEATER GLIDERS

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INDEX

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INTRODUCTION

This book is a guide to two-seater glider training. It is appreciated that experience in this method is comparatively limited and that in the light of future developments some modifications may be desirable.

The purpose of the book is to help the gliding instructor to acquire knowledge before he starts instructing, and afterwards to serve him as a reminder of the principles and methods involved.

The book will only be of real benefit to the instructor if he understands how to use it properly and so some explanation of its arrangement and how to use it is given in the following paragraphs.

So far as is practicable, the information on each exercise has been divided into three parts :—

A. Considerations
B. Air instruction
C. Advice to instructors

PART A.—CONSIDERATIONS—states a problem, and the aim in teaching the particular exercise. It outlines the principles of flight which are involved, gives a summary of all the factors that have to be considered and sets out the main features of the exercise itself.

PART B.—AIR INSTRUCTION—assumes that the pupil has a sound understanding of all the considerations outlined in Part A, and gives a form of words, some of which are suitable for actual use in the air. This so-called patter must be used with great discretion. It is not intended that the exact phrases of the book should be repeated in a parrot-like fashion. The instructor should interpret them in his own way, adapting them to the characteristics of the particular glider and pupil. Some of the explanations are too long to be synchronised with the manœuvres of the glider and in such cases it is a good idea to give the full explanation before performing the manœuvre, and then during the actual demonstration only the particular points to be stressed need be detailed.

PART C.—ADVICE TO INSTRUCTORS—contains suggestions which should be helpful to the individual instructor in teaching the particular exercise. The advice is based on the experience of others ; it should be considered simply as an attempt to hand on hints from those who have had much experience in this work to those who have had little.

In teaching an exercise to a pupil the instructor should divide the instruction into three parts—pre-flight briefing, air instruction, and the discussion after flight.

For convenience of arrangement, and for the purpose of keeping records, the exercises have been numbered. It must be clearly understood that the order and the numbers allotted to the exercises do not in any way imply the order in which they should be taught. Many of the exercises will be taught progressively and concurrently with others throughout the training. It is, however, important that the exercises 1 to 9 should all be completed before the first solo.

The book has been written to cover instruction on all types of two-seater gliders ; therefore it cannot be suitable in every detail for every particular type, and so the instructor must use his commonsense about any particularity of the type in use.

There are a few aspects of flying instruction about which even instructors of experience have marked differences of opinion. In such cases an attempt has been made either to find a compromise between the opposing views or to give alternative methods for the particular exercise. It would be impossible, and, indeed, undesirable, to fix an exact standard which every instructor should follow in every detail. This book is a guide to the instructor, and not a book of regulations ; the instructor should use it as a means of rousing rather than of stifling his imagination and initiative.

THE TECHNIQUE OF INSTRUCTION

1. The technique of teaching anyone to fly is basically the same regardless of the type of aircraft. The method used for teaching any aspect of flying is first of all to explain the purpose of the manœuvre, and then to explain and demonstrate how it is carried out ; thirdly, to get the pupil to do it himself, and, lastly, to correct his faults.

2. When instructing on aeroplanes much of the necessary talking can be done in the air; owing, however, to the short time available on normal glider circuits the talking in the air must be cut to a minimum. Explanations of the exercise to be carried out should be given before take-off. Mistakes made during the flight should not be discussed in the air unless there is an opportunity for the pupil to correct that particular fault in the same flight, e.g., do not waste the circuit by talking about errors made during the launch ; leave the critical discussion till after landing. As the pupil advances, the instructor should progressively reduce the amount of information he gives and at the same time increase the contribution made by the pupil until finally the pupil can do all the analysis and correction for himself.

3. As this pre- and post-flight talking is an essential part of this form of instruction, arrangements must be made whereby the instructor can have a few minutes uninterrupted time with the pupil before and after each flight. This requires that the organisation for take-off and retrieves, etc., should be in the care of somebody other than the instructor, so that the instructor may devote his entire attention to the pupil. If possible two or more instructors should work together, in order to be able to fly with alternate pupils.

4. Models and diagrams should be used freely to clarify and emphasise explanations.

5. It has been found by experience that the pupil learns more quickly if he is given two or three circuits running, if possible without his getting out of the cockpit. This, of course, does not apply if the pupil is cold or frightened.

6. The pupil only really learns anything when he is actually flying himself, and is allowed to make mistakes. It is, therefore, important that he be given every opportunity to do this with the instructor's hands and feet completely clear of the controls, and without unnecessary prompting from the instructor. If, with any particular instructor on board, the two-seater invariably makes good approaches and landings it is obvious that the instructor is not doing his job properly.

7. If proper planning is made by the instructor for the exercises to be carried out in each circuit, it is surprising how much tuition can be given in the short time available without muddling the pupil. Sometimes, however, the instructor may find that because of insufficient height he is unable to let the pupil attempt a manœuvre which he has just demonstrated ; in such

cases it is important that the pupil be given an alternative exercise so that he at least flies for some part of every circuit.

8. On sites where continuous soaring is possible, there is a tendency to think in terms of flying hours rather than launches. It must be realised that the most important part of any glider pilot's training is the approach and landing and it is the duty of every instructor to see that his pupil has really adequate practice in doing this.

9. The pupil cannot be expected to fly properly unless he is comfortable, can reach the controls easily, and see where he is going. This means that the small person must have cushions. It is a complete waste of time flying him without them, and he will find things different each flight unless he is always sitting in the same position.

10. Joyriding and instructing are two entirely different things. If an instructor wants to soar in the two-seater and does not want to instruct, he should make it quite clear to the pupil that this flight is not a lesson. The instructor must ensure that none of his ordinary joyriding pilots give unauthorised instruction to their passengers.

11. If each instructor always flew with the same pupil, it would not matter very much what method of teaching was employed. But as there will always be some interchange of instructor and pupil it is essential that a uniform system is used. This does not mean that the patter must be standardised; this would be absurd, but the same type of circuit, etc., must be taught.

12. An instructor must set a good example in his own flying at all times. If he often lands as close as possible to other gliders he can hardly be surprised if his pupils copy him. In the same way, if he tends to be slapdash about his maintenance and care of equipment, he cannot expect his pupils to know any better.

13. To help himself, and the pupil, the good instructor insists on discipline, and also an atmosphere in which the difficulties can be discussed freely and easily ; the value of a sense of humour as a means of creating such an atmosphere is invaluable. The combination of good discipline with willingness to help by patient explanation and an occasional joke is one of the greatest assets that an instructor can possess.

14. The instructor should study the pupil to find out the best approach to his mind. He should at all times exercise restraint of language, however exasperated he may feel.

One pupil may be nervous or under-confident. Give him more than the usual praise ; do not let him suspect that his flying is other than normal. When flying with such a pupil be careful not to show signs of apprehension in the air.

Another may be over-confident or conceited. Set him difficult tasks and criticise him fairly but firmly for his lack of perfection in performing them. Go back over previous exercises and insist on a really high standard of flying.

There is sometimes a feeling of antipathy between pupil and instructor ; such a feeling may be purely personal and have little or nothing to do with the ability of the instructor or pupil. In such cases the first thing is to try to break down the antipathy, but if this proves impossible the pupil should be transferred to another instructor.

15. The instructor should spare no effort—and it requires an effort—

to speak distinctly, to find out whether he can be heard and to choose the most suitable words and phrases.

16. The instructor should learn all he can about, and if possible fly, the types of glider on to which his pupils are likely to progress. If a pupil asks questions about these aircraft, the instructor should always be able to say something positive and good about them. The same applies to gliding sites. In the past much harm has been done by rumours, often unfounded and quite untrue, about wrongly named " dangerous " characteristics.

17. The instructor should appreciate that his is a very responsible job. If he feels that the pupil is unfit, that the weather is unsuitable, or the equipment unserviceable, he must not allow flying to take place against his better judgment. He will be respected more if he makes firm decisions and sticks to them.

18. Elementary instruction is difficult enough, but dealing with pilots who can already fly is often much more so. This is particularly true of the " old hand " who, because he has survived so long, thinks that his flying is good, and consequently objects to having his faults pointed out to him. The instructor must not let himself be influenced by the status and experience of such a pilot. He must judge him solely by the manner in which he flies, and if he considers that he is not competent and safe, the man should not be allowed to continue without further instruction, whoever he may be.

19. Some record of pupils' progress should be kept, and this is essential if they are being taught by more than one instructor.

20. As far as is practicable a pupil should have the same instructor, particularly up to the solo stage.

21. Any sign of tenseness in a pupil should be observed and checked. Tell him to relax, and watch for this all through the early stages. A pupil who is nervous and tense does not absorb instruction well.

22. Finally, let the instructor think back on those who taught him to fly ; if they were good instructors he knows how they helped him ; if they were bad no one knows better than he in what respects they failed. By following the example of the good and avoiding the faults of the bad and by consulting those more experienced than himself, he should have no difficulty in teaching his pupils to fly well. In doing so he will be making one of the most valuable contributions to gliding which it is possible to make.

METHODS OF TRAINING

The exact method of training will depend on the types of aircraft available, the method of launching, and the site.

Stage of first solo

The pupil should not be sent solo until he has demonstrated when flying dual, to the satisfaction of his instructor, that he is able to carry out all that he will be required to do on his first solo flight. In addition he must have had sufficient experience to enable him to cope with any eventuality which is likely to occur.

It is, of course, possible to train a man dual only to the stage when he is able to do straight hops and landings and then send him solo. Such a course is unsound ; it is far better to continue his training until he is competent to fly circuits.

Solo on two-seater or single seater

Logically the pupil should go solo on the same aircraft in which he has received his instruction. This method has everything to recommend it because the only change with which the pupil has to contend is the psychological one of flying by himself.

However, owing to the present high cost and scarcity of two-seaters, the financial risk of sending a man solo on one is considered by some instructors to be too great, and all solo flying is done on single seaters. This greatly increases the difficulties of the pupil, for apart from the psychological effect of flying by himself he has to deal with the peculiarities of a strange type at the same time. This argument put forward in favour of using a single seater for the first solo is of doubtful validity; admittedly a two-seater may cost three times as much as a single seater, but the fact that the pupil has to cope with something entirely different probably increases the risk more than this number of times.

If a single seater is used, its flying characteristics should be as similar as possible to those of the two-seater. The pupil should not be sent solo until he is competent to do circuits, but in view of the differences in flying speeds, gliding angles, and feel of the controls, it may be advisable to send him off on high straight hops just until he has got used to the aircraft.

Dive brakes

Flying gliders without using dive brakes or spoilers increases the difficulty of judging the approach, particularly if the site is awkward. As the pupil will have to learn to use them at some stage of his gliding career, there can be no objection to teaching their use at the beginning. But whether or not this can be done will depend on what sort of glider will be used for the first solo. If this is the two-seater no difficulty will arise, but if the single seater has no brakes it would be unwise to allow their use dual since the pupil will have none when he goes solo. The same applies if the brakes or spoilers on the single seater have widely differing characteristics ; the pupil will be confused by them.

Instruments

There are two rival schools of thought on the subject of instruments: those who consider the pupil should have them from the beginning of his training, and those who insist that he must be able to fly properly before instruments are introduced. It would seem that as the whole object is to train soaring pilots, who have to fly at slow speeds and, when slope soaring, close to the ground, it is important that they should be able to fly accurately by feel, and not need to rely on instruments in the cockpit.

Pupils are frequently confused following instrument failure if they have been taught to rely upon them. Further, as a glider pilot frequently has to make landings in strange fields the height of which he does not know, it is vital that he be able to judge an approach without the use of an altimeter.

Training pilots to fly on two-seaters with open cockpits and sending them solo without any instruments at all is perfectly practical. It would appear to take not longer than when instruments are used.

For the above reasons the use of instruments is not mentioned in this book until the later stages.

The two-seater will normally carry instruments, but for the early training these should be covered by a removable flap.

On the other hand, particularly if instruction is being given from a silent, closed aircraft, it may be considered advantageous to use an A.S.I. from the beginning of training. If this is done, care must be taken to see that the pupil only uses the A.S.I. as a check, and does not get into the habit of watching it continually.

It is, however, considered inadvisable, regardless of the type of aircraft, to give a pupil an altimeter at this stage of his training.

Seating

Practically all single seater gliders are fitted with the release knob and air brake lever on the left, and the stick is held in the right hand. Pupils should have this arrangement of control from the very beginning ; in the case of tandem seating this will cause no difficulty. Unfortunately some gliders with side by side seating have only one release knob and one brake lever in the centre.

It is better that the pupil should sit on the left-hand side of the cockpit, and thus have a good view when doing left-hand circuits which are the more usual. It is, therefore, strongly recommended that an additional release knob (and air brake lever if it is to be used by the pupil) is fitted on the left-hand side of the aircraft. If this cannot be done, it is better that the pupil sits on the right where he can operate the centrally placed auxiliary controls without crossing hands. The alternative of putting the pupil on the left-hand seat, making him hold the stick in his left hand and operate the auxiliary controls with his right should not be considered.

The pupil should always sit in the same seat. With tandem seating this will always be the front.

PREPARATION FOR FLIGHT

EXERCISE I (A)

CONSIDERATIONS

1. Thorough preparation before every flight is necessary to ensure safety. This preparation is as important as any of the exercises in the air.
2. Before the first few flights the instructor should concentrate on the pupil's comfort, and subsequently lead him gradually to the full procedure.
3. The pupil should be taught to prepare for his flight methodically ; checking both controls and cockpit thoroughly.

EXERCISE I (B)

INSTRUCTION

1. Before getting into the glider :—
   Take a general look over the aircraft.
   See that it is clear of obstructions and in a suitable position for launching.
2. Before allowing the cable to be attached :—
   See that the harness of both occupants is done up.
   Do cockpit check—see that rudder, elevator and aileron controls work freely and in the right sense. Check that the dive brakes are shut, the wheel brake off, tail trimmer set and the cockpit hood (if any) is securely shut.

3. Starting.
   Get the cable attached to the appropriate hook. And make a test release, using the words " Open—Close—Test—Close " when doing this.
   Check that the take off path is clear.
   See that there is no one in front of any part of the glider or near the tail plane.
   See that the wing tip man is holding the wing tip correctly.
   Tell the signaller that you are ready to start the launch.
4. If for any reason you do not wish to proceed with the launch release the cable and shout " Stop " to the signaller.
5. After landing do not get out of the glider until the ground crew arrive.

EXERCISE I (C)

ADVICE TO INSTRUCTORS

1. Before the first flight it is a good thing to explain to the pupil that the harness straps are a device for his safety and comfort. See that they are done up tightly, in the right order, and not twisted. Above all see that he has cushions if he needs them. See that the cushions cannot interfere with the controls.

2. If any system of intercommunication is used, see that the pupil knows how to use it and that it works.

3. Once a pupil has been taught the starting procedure insist that he makes a complete check of this before each flight. Tell him to say aloud what he is doing.

4. It is very easy in the urge to get the glider into the air as soon as possible to hurry the pupil or even to do the check and the hooking on of the cable oneself. This must be avoided and the pupil given every opportunity to do the starting procedure peacefully by himself.

5. The first few days that the pupil is on the field he may feel rather lost. Ensure that someone is detailed to show him how to ground handle and park the glider, how to signal, how to hold the wing tip, and how to attach the cable.

AIR EXPERIENCE

EXERCISE II

1. If a pupil has never before flown in a glider, he should be taken up as a passenger to accustom him to the sensation and to give him the opportunity of looking at the locality from the air.

2. Before the first flight :—
   (*a*) See that the pupil has on suitable clothes and, if necessary, a hat.
   (*b*) Show him how to get into the cockpit and how to strap himself in, and see that he has cushions if necessary.
   (*c*) Point out briefly the various controls in the cockpit.
   (*d*) Tell him very briefly what you are doing in preparation for the flight.

3. Although as far as the pupil is concerned this is in some ways a passenger flight, he should be put in the seat in which he will subsequently fly, and he should be allowed to keep his hands and feet lightly on the controls. Tell him to notice that only small smooth control movements are needed in flight.

4. While it is premature to make any serious attempts at teaching, explain any manœuvres which are simple enough to be understood at this early stage.

5. Point out one or two prominent landmarks. Encourage the pupil to look overboard and to regard himself as part of the aircraft, taking part in and not trying to lean away from bank.

6. To avoid shaking the pupil's confidence only do gentle manœuvres.

7. During the flight watch the pupil to see how he reacts to flying. After landing ask him how he enjoyed it.

8. No one is likely to be sick on a circuit. Do not mention the possibility of this to a pupil before any flight. When soaring, never continue long enough for the pupil to become cold, tired, or sick.

EFFECT OF CONTROLS AND GLIDING STRAIGHT

EXERCISE III (A)

CONSIDERATIONS

1. These are the first few lessons in flying and so should be made as simple as possible.

2. Before the pupil handles the controls he should be shown the best way to hold the stick and how to place his feet on the rudder pedals, and reminded of the need for a light touch and a relaxed and comfortable position.

3. The three movements of an aircraft—rolling, yawing, and pitching—are governed by the three controls—ailerons, rudder, and elevator. When the stick is moved sideways it moves the ailerons, when it is moved backwards or forwards it moves the elevators. The rudder is moved by the rudder pedals.

4. It is advisable that the instructor should explain the effects of the controls with the aid of a model before giving the demonstration in the air. In addition, practice in the use of controls can be given in a glider on the ground, by wing balancing, etc.

5. The primary effect of each control surface is in its own plane, i.e., the ailerons cause rolling, the rudder yawing, and the elevator pitching. These effects are always the same regardless of the attitude of the glider.

6. Like all other bodies a glider possesses inertia ; to alter its attitude a force must be applied for some period. This is especially marked in the rolling plane.

7. If an aircraft is banked (by using the ailerons), the rudder being held central, it will sideslip in the direction of the lower wing. As a result of this sideslip, the air will strike all the side surfaces of the aircraft and will tend to yaw it in the direction of the slip, the nose going round and down towards the lower wing tip. The yaw is due to the fact that the glider has more keel surfaces at the rear (fin, rudder, rear fuselage) than it has in front. It is, in fact, the result of the natural " weather cock " stability of the glider.

The yaw caused by the sideslip is sometimes called the " further effects of aileron control," although it should be noticed that it is only very indirectly the result of the movements of the ailerons.

8. The rudder control may also have a " further effect," but it is of much less importance. If an aircraft is yawed by using the rudder, the ailerons being held central, it will none the less tend to bank. The bank is caused

partly by the outward skid, which is the result of making a flat turn, and partly because the outer wing travels faster than the inner and thus gets more lift. The reason why the skid causes bank is that the natural lateral stability of the aircraft (dihedral angle, etc.) acts in such a way that the outer wing, due to the direction of the airflow, gets more lift than the inner.

Thus the primary effect of the rudder is to yaw the aircraft, and the further effect is to start a rolling movement. Once the aircraft has started to bank the primary effect of the rudder (yawing the aircraft) now causes the nose to drop below the horizon.

9. On most gliders when the aileron control is used coarsely there is also a tendency for the aircraft to yaw in the opposite direction. This is called aileron drag. It is because the down-going aileron has to be pushed down into the full force of the airflow beneath the wing ; that wing produces more lift which rolls the aircraft, but it also produces more drag. On the other wing the up-going aileron causes the wing to produce less lift which also helps the aircraft to roll, but reduces the drag of that wing. The result is that if we apply left aileron the right wing has more drag than the left, and this yaws the aircraft to the right. The effect of aileron drag has unfortunately not yet been completely eliminated on gliders.

10. **Gliding straight.** The aim in gliding straight is to keep the aircraft flying at a steady speed in a set direction without slip or skid. This is most easily done by noting the attitude of the aircraft in relation to the horizon, and by flying towards a set point well ahead.

If it is found that the nose is not pointing in the right direction a very gentle turn using both ailerons and rudder should be made. In order to prevent swinging past the point, the turn should be completed by the time that the aircraft is heading in the right direction. The most common reason for deviations from the straight path is that the pilot allows one wing to drop : frequent checks should be made to see that the wings are level.

Speed. If the speed is wrong the position of the nose should be altered by a small amount and held while the aircraft adjusts itself, and then if necessary a further correction made.

When flying in calm air only very small corrections are required. In rough air, however, a compromise must be made between making excessive control movements in an effort to correct for every little bump, and allowing the aircraft to wallow about.

EXERCISE III (B)

AIR INSTRUCTION

1. General

You will see that if we take our hands and feet from the controls the glider continues to fly on its own. This is because it is designed to be stable. Therefore, do not think that flying is like walking on a tightrope, all that you have to do is to guide the glider in the direction you want it to go.

2. Ailerons

Notice the position of the wing tips in relation to the horizon—you will see they are both level. Now look ahead and you will see how the nose looks when we are flying level.

If I move the stick to the left, the left wing goes down ; to the right, the right wing goes down. Now try that for yourself.

Now look straight in front of you and fly keeping the wings level.

3. **Rudder**

Look straight in front of you and you will see that we are going straight towards that wood (town, cloud, etc.). If I apply left rudder by moving my left foot forward the nose swings to the left ; right foot forward, the nose swings to the right.

Now try this for yourself.

Now try and keep straight towards that wood using the rudder alone.

4. **Ailerons and rudder combined**

If we use ailerons holding the rudder central you will see that instead of flying cleanly through the air we tend to slip and skid. You will tend to move in your seat. Notice that the airflow no longer comes from straight ahead.

The same thing happens if we hold the ailerons central and use the rudder.

This slipping and skidding can be eliminated by using the two controls together ; left aileron and left rudder, right aileron and right rudder.

I now want you to try to keep flying straight using the ailerons and rudder together.

5. **Elevators**

When flying a glider we must always maintain a constant speed—this is the right speed. Notice the position of the nose in relation to the horizon, the amount of noise and the feel of the air on your face.

If I move the stick forward the nose goes down, the noise increases and there is much more air on your face as we go faster.

If I move the stick back the nose goes up and as we slow down it gets very quiet and there is less air on your face.

Try this for yourself ; stick forward, stick back.

Now I want you to try to fly at a steady speed. If the nose is too high and your speed too slow, ease the stick forward a little until the nose is in the right place and then check your movement to prevent the nose going further down.

6. **All three controls**

Now try to glide straight and keep the speed steady, using all three controls together.

7. **Further effects of ailerons and rudder**

Ailerons. If the stick is moved to the left, the rudder being held central, the aircraft will bank and slip down to the left. It will then start to turn in the same direction because of its natural weathercock stability, but being banked the nose will swing round below the horizon and the speed will increase.

Try this for yourself.

Rudder. If rudder is applied, the ailerons being held central, the nose will swing and the aircraft will skid outwards. It will then start to bank in the same direction, partly because of the effect of the skid, but chiefly because the outer wing, travelling faster than the inner, will get more lift. If we continue the turn the nose will go below the horizon and the speed increase.

Now try this for yourself.

EXERCISE III (C)

ADVICE TO INSTRUCTORS

1. Important points in these exercises are :—
   (*a*) The pupil is quite clear in his mind as to which control he is trying to use and its effect.
   (*b*) That he holds the controls properly and is not allowed to grip.
   (*c*) That he realises that the machine is stable.

2. Tell him to look well ahead so that he can see clearly how the aircraft moves in relation to the horizon. In side-by-side two-seaters make certain that the pupil looks straight ahead of himself through his own windscreen. Any attempt to steer by some centrally placed object, such as the pitot, will later cause trouble in landings, when the pupil will tend to drift through flying with crossed controls.

3. Demonstrate each point and then tell the pupil to try it himself. This principle should apply to all your instruction.

4. Do not assume that the pupil finds it at all easy to understand ; he may have difficulty in appreciating even most simple effects, especially if they have not been properly explained on the ground.

5. Get the pupil to use the ailerons alone until he is thoroughly used to them. Then make him use the rudder alone just until he has realised its effect. Then make him combine the two, emphasising that the aileron is the primary control for direction, and that if one wing is down it will be impossible to keep straight.

6. When he is able to fly easily using ailerons and rudder together he can be introduced to the elevator. Make him fly at a reasonably fast speed so that if he gets a bit slower than this he will not be near the stall. As soon as he is able to use the elevator, let him fly with all three controls together.

7. If this instruction is being carried out from circuits arrange the flight so that you have to take over for turns as infrequently as possible.

8. The majority of pupils will be completely unable to understand explanations and demonstrations of the further effects of the controls and of aileron drag if they are given in the first few lessons. Unless the pupil is curious or has any particular difficulty they should not be given until just before starting instruction on turns.

9. Encourage the pupil to hold the controls all the time and ensure that he knows who is flying the aircraft. When you take control, standardise on " I've got her," and when you hand over control say " She's all yours," and put your hands up. In the case of tandem seating the pupil must reply accordingly.

10. Do not allow the pupil to get into extremes of attitude.

11. Do not allow the pupil to look down into the cockpit to watch the position of the controls.

12. As soon as he is beginning to get the idea of flying straight make him look around. He may be reluctant to do this because he feels that he cannot fly so accurately. Tell him that it is worth sacrificing a little accuracy in order that he may be certain of avoiding collision.

13. These lessons will be made very much easier if they can be made in calm air. If lessons are given in rough air, not only will the pupil not progress, but he will get a false idea of difficulties.

14. Most pupils have extreme difficulty in realising that a glider flies through the air, and that once it has left the ground the wind has no effect on the manner in which it flies. Make sure that he really understands this.

When dealing with the airspeed never say " wind on your face " or you may confuse him ; instead use " air on your face " or " airflow on your face."

MEDIUM TURNS

EXERCISE IV (A)

CONSIDERATIONS

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

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

3. Since the lift must be sufficient both to support the aircraft and to provide the inward force, it must be greater than in straight flight. This increase in lift can only be achieved by increasing the airspeed or by some increase in the angle of attack or both. Unless the airspeed is increased by the pilot the angle of attack may approach that of the stall. However, this effect is not very pronounced in medium and gentle turns, but becomes important in steep turns.

4. The best method of teaching has been found to be to think of each control as having one definite function during the turn ; the ailerons controlling the angle of bank, the elevators the position of the nose, and the rudder preventing or correcting any slip or skid. This makes the whole conception of the turn and the correction of faults simple for the pupil, and it eliminates some of the common mistakes such as the application of too much rudder.

5. It has been explained in the consideration of earlier exercises that if an aircraft is banked it will automatically yaw owing to its natural stability. The rudder is not used primarily to yaw the aircraft. It need only be applied if there is appreciable slip. On most gliders this slip is noticeable and rudder should be used, but only so much as is necessary to correct the slip. After a little practice there will be no need to wait for the slip to occur before correcting it; the pilot anticipates it. If rudder is used during a turn it is called " bottom rudder " when applied towards the lower wing, and " top rudder " when applied towards the higher wing.

6. In some gliders the application of aileron may cause the aircraft to yaw in the opposite direction to that in which it is desired to turn; this effect is called aileron drag and has already been explained. In such types a certain amount of rudder in the direction of the turn will be needed to counteract the adverse effect of the ailerons, but there is no need to worry about this as a special case since the result of the aileron drag is simply to make the aircraft more inclined to slip inwards and this will be prevented or corrected in the usual way by the application of rudder in that direction.

7. When a glider is turning, the inner and outer wings travel on different paths and this causes two effects: (*a*) the outer wing going faster than the inner tends to get more lift, and (*b*) the outer wing travelling on a larger spiral is flying at a smaller angle of attack than the inner wing and so tends to get less lift. These two effects more or less cancel each other out, although on some high performance gliders the effect of the outer wing travelling faster is the greater, and so the angle of bank tends to increase. The important consideration is to keep the bank constant, and the pilot uses his controls accordingly. Such terms as " holding off bank " may be misleading and should be omitted altogether from instruction.

8. The importance of look-out in this exercise must be stressed. It is not sufficient to look round before the turn and before coming out: even during the turn it is necessary to keep looking round.

9. A medium turn is made by applying bank, with ailerons; and the yaw is produced for the most part automatically by the resultant slip acting on the weathercock stability, but is helped by rudder if such stability is insufficient. During the turn the bank is held constant with the ailerons and the yaw is automatic; but if there is any slip or skid, rudder is applied in the direction of such slip or skid. To come out of the turn, bank is taken off with the ailerons, and the yaw is eliminated by weathercock stability, any skid being corrected by rudder.

10. **Faults in turns.** If the bank is held constant and at about 30 degrees few faults are likely to occur. Too little bank will result in too little turn, otherwise no harm will be done. Excessive bank will result in a steep turn and may get out of hand, so the bank should be kept constant throughout the turn. The nose may rise above or fall below the horizon, and this is corrected by use of the elevator. If the glider is slipping in it can be felt by the pilot tending to slip inwards on the seat; this is corrected by applying bottom rudder. Skidding out can only happen if too much rudder is applied.

In correcting one fault it may be found that another is caused, e.g., when the rudder is moved to correct slip or skid it may cause the nose to move above or below the horizon which in turn may necessitate elevator movement. But it is easier to think of each fault separately, and in practice smooth co-ordination of the controls is soon achieved.

EXERCISE IV (B)

AIR INSTRUCTION

The correct turn

First " going in "

Look round.

Apply bank smoothly in the direction in which it is desired to turn, and at the same time apply sufficient rudder in the same direction to prevent slip.

When the desired angle of bank is reached keep it constant by use of the ailerons, and prevent the aircraft from skidding by taking off rudder.

Keep the speed steady by slight movements of the elevator control.

" Staying in "

Keep the angle of bank constant and the nose travelling steadily around the horizon. See that the speed remains constant.

Look round frequently during the turn.

" Coming out "

Apply opposite bank and sufficient rudder to prevent the aircraft skidding. Keep the nose in the correct position relative to the horizon with the elevator.

Faults in turn

If the turn does not feel right, first check the angle of bank, and correct with the ailerons if necessary.

Check the speed and the position of the nose, and adjust with the elevator.

Having got these two right, decide if you are slipping in or skidding out. If you get the sensation of falling in towards the inner wing tip and there is a draught on that side of your face you are slipping in. Correct by applying bottom rudder.

If you get the feeling of being thrown outwards and there is a draught on your outer cheek you are skidding out. This is because you have too much rudder ; take some off.

EXERCISE IV (C)

ADVICE TO INSTRUCTORS

1. There is a tendency for the pupil to allow the angle of bank to increase during the turn until he wants to come out. Insist on the turn being made in three stages : " going in," " staying in " and " coming out."

2. In spite of all the efforts of the instructor, one of the most common faults in turning is excessive use of the rudder. This is particularly noticeable in the case of pupils who have had solo training. This fault can only be eliminated by making sure that the pupil understands that the rudder is not the primary turning control. He must be made to make alterations of direction, however small, primarily with the ailerons.

3. Explanation of the faults in turns and methods of correction should be given on the ground. It should be emphasised that the angle of bank must be kept constant throughout the turn, and that if the pupil realises that he is making a bad turn the first thing to do is to check the angle of bank, then check the position of the nose, and then check for slip or skid.

The conception of slipping and skidding is not very difficult for the pupil to understand once it has been thoroughly explained to him. But he finds the difficulty in deciding what is the matter with his turn in the air.

If the pupil continues to find difficulty, demonstrate a continuous turn yourself, alternately slipping and skidding from a correct turn. Get the pupil to tell you what you are doing and what corrections should be made.

No pilot really understands turns until he can give this demonstration himself.

4. Teaching a pupil to keep a good look out is the most difficult part of flying training. Insist from the very beginning of this exercise that the pupil looks well round before each turn. The pupil will find it easiest to look in front of him and watch the nose travelling round the horizon when doing turns ; he must not be allowed to do only this.

5. On side-by-side two-seaters the pupil sometimes has difficulty in keeping his speed right as the nose appears to be in a different position in left and right turns. This tendency can be avoided by getting the pupil to consider that part of the windscreen immediately in front of him as the nose.

6. Instead of telling the pupil to " straighten up now " from a turn give him a definite feature on which to come out.

7. If instruction in turns is being given on winch circuits the instructor should ensure that the flight is so arranged that the pupil does the maximum amount of flying. If the instructor allows the aircraft to get badly out of position for the final approach he will have to take over himself, and thus waste valuable practice for the pupil.

8. Some instructors have made a habit of having a length of string tied to the pitot head for use as a slip or skid indicator. With side by side seating this is unsatisfactory. If fitted on the centreline it cannot be correctly interpreted owing to parallax, while, if fitted in front of the pupil, the divergent airflow around the nose upsets it. The pupil should be taught to recognise slip and skid by the feeling on his bottom and the airflow on his face.

STALLING

EXERCISE V (A)

CONSIDERATIONS

1. The aim of this exercise is to teach the pupil to recognise the approach to the stall, to learn what the stall feels like and how to recover from it with the minimum loss of height.

2. In order that a glider may fly at all, the wing must produce lift equal to the load upon it. The lift produced by a wing depends on the speed of the airflow past it and the angle at which it is held to this airflow. If the glider is flying fast this angle, called the angle of attack, is quite small. When the speed is reduced, the angle of attack is increased. But the speed cannot be reduced indefinitely, because at a certain angle of attack the airflow over the top of the wing breaks away and the lift gets less. The nose drops even if the stick is moved further back. This is known as the stall.

3. The wing will always stall at the same angle of attack, that is, the same angle between the chord line of the wing and the airflow. For most aerofoil sections this angle is about 15 degrees. This angle must not be confused with the angle at which the glider is flying in relation to the horizon. The glider will stall in any attitude whenever the angle of attack reaches this critical angle.

4. The speed at which the stall occurs depends on the load which has to be carried by the wings ; if the load is increased the stalling speed becomes higher. The weight at which a glider is flown does not usually vary very much and so in straight flight the stalling speed will always be more or less the same. If, however, the glider is being flown around a curve, either in a turn or by pulling out of a dive, the wing will have to carry an extra load due to the centrifugal force, and this will increase the stalling speed.

5. Symptoms of the approach to the stall are :—

(*a*) The position of the nose. If the nose is held too high for any length of time the glider will stall.

(*b*) Slow airspeed shown by absence of noise, reduction of airflow on the pilot's face.

(*c*) Ineffectiveness of the controls, particularly the ailerons.

(*d*) Increased rate of descent, even if the stick is moved back.

(*e*) On some types of gliders a buffeting of the tail surfaces may be apparent.

6. In order to recover from a stall, all that is required is to reduce the angle of attack until it is below that at which the airflow becomes turbulent. This may happen to some extent automatically, because at the stall the nose drops and the glider takes up a new flight path, but the reduction in the angle of attack is assisted by moving the stick forward. The recovery from the resultant dive is made by gently easing the stick back.

7. Sometimes if the glider is not flying straight or has one wing down, or if the air is gusty, one wing may drop at the same time as the nose. If this happens opposite rudder should be used as a means of keeping straight. The ailerons may be quite ineffective or may even have the opposite effect to that desired, since the result of lowering the aileron on the down going wing is, in effect, to increase the angle of attack of that wing still further. Hence its lift will be reduced and it will continue to drop. As soon as speed has been gained the aileron can be used to level the glider in the ordinary way.

EXERCISE V (B)

AIR INSTRUCTION

Turn the glider to make sure that there are no other aircraft nearby, especially below.

Bring the nose above the normal gliding position and keep it there by bringing the stick gently further and further back.

As we get slower the noise and the airflow on your face get less and less, and the time comes when, although we go on moving the stick back, the nose drops of its own accord. That is the stall.

To recover, ease the stick slightly forward and allow the glider to pick up speed.

That was quite a gentle stall. I now want to show you another one with the nose rather higher above the horizon. You see that the stall is rather more sudden and the nose drops further down. We recover as before.

The controls get less effective as we fly more slowly; you see that as we fly slower and slower the ailerons get more and more sluggish, and at the stall they hardly work at all. If a wing drops the aileron will not help much; keep straight with the rudder, and then use the ailerons to level the aircraft when speed is gained.

Try a stall yourself. The important thing to notice is the sensations as we approach the stall—the absence of noise—and the lack of airflow on your face, and the ineffectiveness of the controls.

EXERCISE V (C)

ADVICE TO INSTRUCTORS

1. Try to convince the pupil that there is nothing alarming or dangerous about stalling, and that he can be quite confident in taking any glider to the point of stall provided that he is at a reasonable height, and provided that he knows the method of recovery. Set out to make him feel happy and confident about it all. Get him to do a number of stalls himself to see how easy it is.

2. The pupil will do better if he understands what is happening and why. Ensure that he understands about the angle of attack. He will have some difficulty in grasping the fact that the airflow does not come horizontally but from the direction of travel of the aircraft. Diagrams will help.

3. Never forget the aims of this exercise—to teach the pupil to recognise the approach to the stall in order that he may avoid it, and should one occur accidentally, to recover instinctively and with the mimimum loss of height.

APPROACH AND LANDING

EXERCISE VI (A)

CONSIDERATIONS

In this section the use of spoilers, dive brakes or of sideslipping is not being considered.

1. The first consideration in making a good landing is to make a good approach ; and a good approach is the result of a good circuit ; therefore we will first consider the problems of the circuit.

2. Since we are ignoring the use of any method of increasing the angle of glide, for any given height of launch the glider will travel a certain distance through the air before it comes into contact with the ground. The problem of the circuit is to fly a path of this length so that the glider touches down in the desired part of the landing ground.

3. Planning of the circuit is made easier if a certain basic shape is adopted. The conventional and simplest shape is the square circuit, consisting of a cross-wind leg, a down-wind leg, a second cross-wind leg and the final approach straight into wind, with turns through approximately a right-angle between legs.

4. It is highly undesirable to do low turns. The last turn into wind should have been completed by a height of about one hundred feet. The distance the glider will travel from this height into wind depends, of course, on the wind speed, but unless the wind is strong the glider will go a considerable distance after the final turn.

5. For the purpose of circuit training the approach must be considered to start as soon as the cable is released. As soon as the speed has been corrected the glider should be turned on to the first cross-wind leg, and the pilot must at once consider how much height he has available for his circuit. If he thinks he is high this leg should be continued, whereas, if he thinks that he might be low he should get on to the down-wind leg at once. The down-wind leg should be used for making major adjustments, and the pilot should consider all the time that he is flying along this leg his position in relation to the landing ground. If he considers that he is high he should edge away from the landing ground, and if low, edge in towards it.

6. The position in which the second cross-wind turn is made will depend on the height available and the strength of the wind. Normally the turn will be made when the glider is some distance down-wind of the boundary of the landing ground, but as the vital consideration is to keep at all times within easy gliding distance of the field, if the wind is strong the glider must not be allowed to go far down-wind.

If the glider is very low the turn will have to be made early, before reaching the down-wind boundary. If the glider is high the turn can be delayed, but not so much that an excessively long into-wind leg will be required.

7. As the turn is being made, the pilot must again consider his position in relation to the landing ground, judging the angle at which it appears to him, and his height. If the approach has been judged correctly so far he will straighten up and fly across wind. If he has any doubts about his height he must continue the turn and fly straight in towards the field ; while if he thinks that he has too much height he should not turn so far, so that his cross-wind leg will edge him away from the landing ground.

The strength of the wind can be assessed by noting the way the glider is drifting ; if the drift is appreciable the nose of the glider will have to be turned in towards the field in order that a track across wind can be made good.

Judgment of the moment to start the final turn is difficult ; it is partly a matter of noting the height and distance away from the boundary, but much more one of observing the angle at which the landing ground is seen.

In the perfect circuit this turn will be made as the glider approaches the line of the landing run. However, even with the most perfect piloting this cannot always be achieved, as thermals, or sinking air, upset the approach. If the glider is too high as it gets down-wind of the landing line, the cross-wind leg should be continued either until it is in a position from which the final turn can be made or, if it is still too high, turned back so as to fly across wind in the opposite direction. (This process can be continued indefinitely, the glider beating to and fro across wind, until sufficient height has been lost to make the final approach.) It is essential that the turns at the ends of the beats be made into wind, otherwise the landing ground will become out of sight and, if the wind is strong, the glider will be blown a long way down-wind.

Beats of sensible length should be made in order to keep the number of turns to a minimum.

8. The final approach should be made as smoothly and steadily as possible, towards a part of the landing ground which is smooth and free of obstructions. The glide is continued at constant speed down to a height from which a progressive flattening out can be made. The glider should then be kept just off the ground until the speed is right for landing. It is then allowed to sink gently on to the ground, touching main wheel and tail skid together.

9. After landing the glider is kept straight and the wings level by coarse use of the controls.

10. **Wind gradient.** This rather confusing term is used to describe the diminution of wind strength near the ground. It was said earlier that the wind has no effect on the way in which a glider flies ; this is not quite true. If the glider is flown *suddenly* into a region in which the wind is blowing at a different speed, the airspeed of the glider will be affected for a short time until it has steadied down in the new conditions. Hence if a glider is coming in to land against a strong wind (which will be blowing less strongly close to the surface of the ground), the airspeed will tend to fall off as the glider gets closer to the ground. This can only be obviated by putting the nose further down during the last stages of the approach, and thus ensuring that the glider has plenty of speed.

In any case the approach in a strong wind should be made at a faster speed than usual in order to ensure adequate control in the turbulent air.

11. If the decision to make left- or right-hand circuits is not determined by outside circumstances (flying control, proximity of hill, etc.), the following two considerations should be taken into account when choosing the direction.

(*a*) Wind. If this is tending to come from one side of the launching run, or if a sudden veer is expected, the direction should be chosen so that the glider has to turn less than 360 degrees in order to get round into wind.

(*b*) Sun. If the sun is particularly glaring it will be easier to make the final cross-wind leg down-sun.

(*c*) The pupil should be given practice in circuits in both directions.

EXERCISE VI (B)

AIR INSTRUCTION

The Circuit. Normal

At the top of the launch get steady and then turn across wind. Consider your height. If you think that you are low turn down-wind. If you think you have plenty of height continue across-wind in order to make a bigger circuit.

Now turn down-wind.

As you fly down-wind keep looking at the landing place. If you are low, edge in towards it. If you have plenty of height get further away.

Turn across-wind when you are a short distance down-wind of the landing ground.

Again, if you are low, turn straight in on the final approach. If you have plenty of height continue across-wind. You can judge the strength of the wind by the way the glider drifts. Have a good look round for other aircraft.

Keep looking at the place where you want to land and try to judge your angle from it. When you think you are right turn in towards the field on your approach.

The low circuit

If you get a very poor launch you must get on to the down-wind leg as soon as possible. Keep close to the landing ground and turn into wind early, so that your turn is completed at a good height. This will mean that you may land near the up-wind end of the field ; it is better to do this rather than make a low turn.

The high circuit

If you arrive in the position where you would normally do your final turn into wind too high, carry on across-wind. Then turn and fly back across-wind in the opposite direction. Continue beating backwards and forwards until you are in a position to do the final turn into wind.

It is vital that at no time should you lose sight of the landing ground. Always do your turns towards it.

The final approach and landing

Having done the final turn, get your speed steady and aim towards the least obstructed part of the landing ground. If the glider is drifting sideways, you are not flying into wind. Work out which way you should turn in order to do this.

Remember to look well ahead for the landing.

At a reasonable height—this is about it—gradually start to level out so that the glider flies along just above the ground. Keep it just off the ground until it is in the right attitude for landing. When you are on the ground keep the wings level and go straight by coarse use of the ailerons and rudder.

EXERCISE VI (C)

ADVICE TO INSTRUCTORS

1. The approach and landing is a matter of judgment, and there is no simple way of teaching judgment to those to whom it does not come easily.

2. The average pupil takes time to learn how to judge the circuit; do not be discouraged yourself and do not let him be discouraged if there are no obvious signs of improvement during the first few lessons.

3. The instructor's task is particularly difficult in this exercise. The pupil cannot learn unless he is allowed to make mistakes, but mistakes, particularly undershoots and heavy landings, must not be allowed to result in damage or undue risk to the aircraft.

4. The square circuit is not applicable to all circumstances, but if the pupil has had plenty of practice in this he will be able later to adapt himself to varying conditions.

5. Diagrams will be a great help, both in explaining the type of circuit to be made, and in showing the pupil what he did.

6. It is extremely difficult to judge an approach accurately without sideslipping or using the dive-brakes. Explain this to the pupil and tell him not to worry if he overshoots a little—spot landings come much later.

7. If you are teaching these circuits without the use of dive brakes, do not use them at all. When a pupil is over-shooting and is going to land up at the far end of the field, there is a strong temptation to use brake in order to avoid a long retrieve. This temptation must be resisted ; if the pupil can get in safely in a straight line, let him. If not, let him sort things out for himself.

8. The pupil often has difficulty in knowing what he has done in landing. The first few times tell him what happened, but afterwards try and get him to tell you. In this way you will soon be able to find out how much he notices and whether he really understands what he is trying to do.

9. Pupils need guidance on where to look during the hold-off. Tell them to keep looking at a point about forty yards ahead. This point should be in the centre of vision ; not at the top of it. The picture should include the far horizon. If one is looking too far ahead, objects will hardly appear to move, while if too close they will move too fast to be recognised.

There is a tendency to look too close. In side-by-side two-seaters the instructor can look at the pupil's eyes to see where he is really looking.

10. The glider should be held off just above the ground until it is in the right attitude for landing. If the pupil has difficulty in judging this and always lands too fast get him to notice the position of the nose when the glider is at rest on the ground in this attitude, and then next time he makes a landing to hold off until he sees the same picture.

11. Do not talk about the position of the stick when landing. Refer to the attitude and height.

12. It is important that the pupil be made to keep the aircraft straight and the wings level until it actually comes to rest. He will find this difficult. Get him to do it every time.

13. Finally, remember that a pupil will never make good landings unless he makes good approaches at constant and correct speeds, and that he will never make such approaches unless he learns to fly the circuit properly. The moral is clear.

TAKE OFF AND CLIMB

EXERCISE VII (A)

CONSIDERATIONS

Winch and auto-tow

1. The object is to get the glider to the maximum height without endangering the aircraft or imposing undue stresses upon it. This means that the launch must be so made that it does not impose excessive loads on the cable, and also that should the cable break at any moment, the glider will be in a position from which it can safely be landed.

2. The action in the event of a cable break is described in section IX.

3. The launch can be divided into five parts :—

(*a*) The ground run
(*b*) The take off
(*c*) The initial climb
(*d*) The climb
(*e*) The release

(**a**) At the beginning of the ground run coarse use of the ailerons will be necessary to keep the glider level.

The actual technique of using the elevator control will vary to some extent with the aircraft—the position of the hook and the type of undercarriage. However, on gliders which have a wheel placed slightly behind the centre of gravity, the best technique is to get the glider running along on its wheel, without either nose or tail skid touching the ground.

(**b**) The glider should be allowed to take itself off.

(**c**) The initial climb must be made smoothly and gently. The position of the release hook will determine the extent to which the elevator control has to be used.

(**d**) By the time that the glider has reached 100 feet or so it should be climbing steeply. The angle at which the climb can be made will depend on the position of the hook, the speed of the launch and the roughness of the air. If the speed is slow, it is inadvisable to attempt to climb steeply because the aircraft will " mush " and this will apply more load on the engine which may make it difficult for the winch or car driver to increase speed. If, on the other hand, the launch is fast, the glider should not be climbed more steeply in order to reduce the speed as this will impose heavy stresses on it.

Certain gliders with the release hook fitted far forward may "buck" during the latter part of the launch. This bucking, which takes the form of a rhythmical pitching oscillation, can be damped out by easing the stick slightly forward and holding it still.

The stresses on a glider during a launch are considerable even in calm air ; if the air is rough and the glider is climbed very steeply the stresses will be severe.

The glider is kept straight on the climb by keeping the wings level.

Winch or auto-tow launches may often be made out of wind. Under this condition the greatest height will be obtained by keeping the nose towards the winch and allowing the glider to drift. The disadvantage of this is that the cable may be dropped in an inconvenient position. It is better, therefore, to make the climb on a straight track over the line on which the cable was laid out. This can only be done by keeping the windward wing down slightly.

(e) The release will normally be made when the glider has reached its maximum height; this, of course, occurs before the glider arrives over the winch.

On many gliders it is impossible to see the winch during the later stages of the climb, and so some prominent feature to one side of it should be noted before take off.

The nose should be lowered just before the release knob is pulled. This is done in order to reduce the load on the hook and so make releasing easier, and also to prevent the nose from jerking up.

Surprisingly enough, pilots may sometimes forget to release or fail to give an effective pull. To avoid this the pupil should be taught to pull the release knob hard at least twice when desiring to release.

Owing to the possibility of a failure at any stage of the launch and the need for immediate release, the pilot must be able to do this without any delay. He should, therefore, be taught, from the time that the cable starts to tighten at the beginning of the launch, to after release, that his hand should be holding the release knob. On gliders where the design is such that this may cause an inadvertent release, his hand should be kept as close to the knob as practicable.

EXERCISE VII (B)

AIR INSTRUCTION

1. Carry out preparations for flight.
2. See that take off path is clear.
3. Tell signaller that you are ready to be launched.
4. As the glider moves forward keep the wings level and the glider straight with coarse use of the ailerons and rudder. Use the elevator to get the glider running steadily on its wheel.
5. Allow the glider to take itself off and do the initial climb gently.
6. As height is gained, cause the climb to become progressively steeper.
7. Keep straight by keeping the wings level, and the climb steady.
8. Keep looking out to see how the launch is progressing and when the winch is nearly underneath (or the tow car has reached the end of the run) put the nose down and release by pulling the knob hard twice.

EXERCISE VII (C)

ADVICE TO INSTRUCTORS

1. It should be remembered that the launch is an abnormal condition of flight.

2. Different gliders have different launching characteristics from the point of view of stick position and stick load. But they all climb at much the same attitude. It is important that the pupil be taught to judge the launch by the position of the nose and not by the stick position, otherwise he will find difficulty when flying a new type.

3. It is difficult to keep the wings level during the launch, particularly if the glider has side-by-side seating. Get the pupil from the beginning to see that the horizon on either side of the nose is in the same position.

4. Make sure that the pupil really does do a cockpit and control check.

5. Although the pupil will not do the launch until quite late in his training, it is a good idea from an early stage to get him to tell you when he thinks the glider should be released. Apart from practice in judging the release it helps him to relax and look out.

6. Teach the pupil to do the climb before teaching him to do the take off.

SPINNING

EXERCISE VIII (A)

CONSIDERATIONS

1. A spin is a condition of stalled flight in which the aircraft makes a spiral descent, losing height rapidly. During a spin the aircraft is simultaneously rolling, pitching and yawing: its motions are, to a large extent, automatic and outside the control of the pilot.

2. The spin is a result of faulty flying caused by misuse of the controls. Whenever the aircraft is near the stall there is a possibility of a spin developing, especially if the rudder or ailerons are producing a roll or yaw.

3. In a spin the inner wing is more fully stalled than the outer, and so this inner wing produces less lift, but also, because it is at a higher angle of attack, more drag than the outer one. This drag causes the aircraft to rotate.

4. The actual form which a spin takes varies in different types of aircraft; some spins are steep and quick, others flat or slow. Some gliders will spin continuously if the stick is held back and full rudder applied, but other types may alter their spinning characteristics after a few turns. The glider may come out of the spin of its own accord, or, alternatively, the airspeed may increase and the spin change to a spiral dive. For any particular aircraft the position of the centre of gravity will have an effect on its behaviour in a spin.

If the C.G. is far forward it may be difficult to hold a spin, or even start one at all: while if it is further back the glider can probably be made to spin continuously.

5. Spinning is very seldom used as a deliberate manœuvre. At one time it was considered that a spin should be used if a pilot got into difficulties when cloud flying, but this practice is hardly ever used since it may be difficult to get into and hold the spin, and, in any case, now that gliders are fitted with dive brakes these can be used instead.

6. Since most gliders will spin it is important that the pilot should know under what circumstances a spin can occur, how to recognise one, and how to recover from it. The earlier that he can start the recovery the less height will be lost. Hence the instructor should concentrate on teaching a pupil to recover as soon as the aircraft has shown a tendency to start to spin—this is called the incipient spin. It is, however, also important that the pupil be familiar with the sensations of a protracted spin and be able to recover from one.

7. Most gliders will recover from a spin if the controls are centralised; but recovery may not be very quick and this method will not always be successful. Only the standard method of recovery, given below, should be taught, as this has been found to be the most effective on all types of aircraft.

8. The standard method of recovery from all spins and incipient spins is, FIRST to apply full opposite rudder, a slight pause, and THEN to move the stick steadily forward until the spinning stops. The rudder is applied to stop the rotation, but the spin will not stop unless the wings are unstalled, so the stick must also be moved forward. On some types of aircraft, if the stick is moved forward at the same time as the opposite rudder is applied, the rudder or elevator may be ineffective, probably because one is shielded by the other. That is why the standard method is to apply rudder first.

9. Most gliders will recover as soon as the opposite rudder has been applied, and the stick moved a very small distance forward. It is, however, very important that the pupil understands that this is only part of the full procedure, and that on certain types of aircraft the stick has to be held hard forward for one or two turns of the spin before the aircraft will recover. He must remember the procedure as " apply full opposite rudder and then move the stick steadily forward UNTIL THE GLIDER STOPS SPINNING."

10. The use of the ailerons is not likely to have a very marked effect on the type of spin. It may be necessary to use opposite aileron to initiate the spin, but once it has started the ailerons should be centralised.

11. Most gliders fitted with dive brakes will spin with them open or closed, but the glider may be more reluctant to spin with them open.

12. Considerable height may be lost during spins and the recoveries ; they should not be practised too low down.

13. A pupil must be proficient in recognising and recovering from an incipient spin before he goes solo. If it is possible to show him a full spin of a turn or two this should be done.

EXERCISE VIII (B)

AIR INSTRUCTION

Turn to make sure that there are no other aircraft nearby, especially below.

I am now going to show you how it is possible to spin off a really bad turn. I am doing this horrible slow turn with much too much rudder and very little bank. We go round perfectly steadily, but if, as the nose drops, I try to keep it up by pulling the stick further back, this happens. This is a spin.

Come out—full opposite rudder, then stick forward steadily until it stops spinning; then centralise the rudder, level the wings with the ailerons and pull gently out of the dive.

We will now try one the other way, but this time we will not let it spin so much ; as soon as the nose drops down to one side we will come out. The procedure is exactly the same.

Here we are doing this slow turn with much too much rudder. I get slower and slower and keep the nose turning by putting on more rudder ; as the nose drops I try to keep it up by pulling the stick back, and the spin starts. Come out—opposite rudder, stick forward, centralise rudder, level with ailerons and ease out of dive.

Now try this for yourself.

EXERCISE VIII (C)

ADVICE TO INSTRUCTORS

1. Most pupils approach spinning with some apprehension. The instructor should try to remove this, first by explaining that there is no deep mystery about it all, and secondly by demonstrating how easy it is to recover at any stage of the spin.

2. There is no great merit in doing prolonged spins—the really important thing is that the pupil should, himself, be able to recognise an incipient spin and make a quick recovery with the minimum loss of height.

3. Make sure that the pupil really understands how people manage to spin in—the pilot undershooting so he stupidly flies slowly, his reluctance to put on bank because he is low down, the resulting attempt to turn with too much rudder, the pull back on the stick as the nose drops, and the consequent spin. Alternatively, the pilot who is flying much too slowly when slope soaring and spins off a turn in the gusty air.

4. Emphasise that the recovery action from a spin is not what one would do instinctively ; as the spin starts and the nose drops away every instinct says " Pull back on the stick." Reason must take over and say " I am spinning —opposite rudder, stick forward."

5. There is little object in demonstrating spins from straight stalls; the demonstration should be made from a badly executed turn, and it must be convincing. On some gliders a lot of opposite aileron will have to be held on in order to start the spin; do not hide this, but explain how a pilot may do this when making a bad turn.

6. The first few spins, even those of only a quarter of a turn, are rather frightening. The pupil will not feel nearly so worried when he has done one himself, so try to arrange this in the same flight. In gliders with side-by-side seating it is less alarming to be seated on the outside of the spin and so, if the pupil is a nervous one, the first spin should be made in the direction opposite to the side on which he is sitting.

7. Spins should preferably be done high up, but the risk involved in doing them dual with a competent instructor from a high winch or auto-tow launch is one which can certainly be accepted. However, while it is extremely important that the pupil gets practice in spinning solo, he must not be allowed to do this below a height laid down by the instructor (say, 2,500 feet) until he is really experienced. He must be told about this, otherwise, seeing the two-seater spinning at a lower height, he may think that this is the normal procedure, and do the same.

8. In all the flying exercises up to this one, emphasis has been placed on moving the controls very gently and slowly. In recovery from a spin, they must be moved decisively. The pupil may have some difficulty in grasping this idea. On the other hand it must not be carried to an extreme, particularly with the elevator control, or else, if a pupil is slow to realise when the glider has stopped spinning he may continue to move the stick quickly forward and get into a steep dive.

9. If a pupil has difficulty in pulling out neatly from a dive, practise this off a straight dive without doing a spin at all.

CABLE BREAKS

EXERCISE IX (A)

CONSIDERATIONS

1. The glider must be flown on every launch in such a way that should the winch or auto-tow cable break at any moment during the launch the glider can be safely landed.

2. Unless the glider is fitted with a hook placed very far aft, when the cable breaks the nose, suddenly relieved of the cable load, will rise still higher.

3. In order to maintain control it is necessary to retain flying speed. To do this the nose must be put down at once. If, when the cable breaks, the

climb is being made at a slow airspeed, and at steep attitude, the glider will decelerate rapidly ; considerable height will then be lost in getting the nose down and allowing the speed to build up again. If, however, a less steep climb is being made at a faster airspeed very much less height will be lost in the recovery.

It follows, therefore, that the glider must not be climbed steeply or at a slow speed until it is well clear of the ground.

4. The cable does not break of its own accord ; it breaks when a heavy load is put upon it. In order to avoid this the launch should be made as smoothly as possible and very steep climbs should not be made in gusty conditions. In particular the transition from level flight at take off to the steep climb at 100 feet or so should be made without a sudden change of attitude.

5. It is essential that the cable be released from the glider immediately the launch fails.

6. The action to be taken after the glider has been put in the gliding attitude and the cable released will depend on the height at which the break occurred and the size of the landing ground. If it is possible to land straight ahead without overshooting this should be done. But if this is impossible an " S " turn will have to be made. As it is extremely difficult to judge from a low height when a circuit is possible, a circuit should be made only if the pilot is quite sure that he has ample height to do this.

7. If a break occurs when taking off in a strong wind more height will be lost in the recovery than it would in still air owing to the wind gradient effect.

8. The above considerations still apply in the case of a failure of the motive power of the launch, but as the failure may come gradually it is important that the pilot does not hang on to the launch in the hope that it will pick up for such a long time that his speed gets dangerously low.

9. Since it may be necessary to release instantly at any moment during the launch, it is of vital importance that the pilot either holds the release knob, or, if this is so arranged that doing this might lead to an inadvertent release, keeps his hand close by it.

EXERCISE IX (B)

INSTRUCTION

1. If the cable breaks :—
   (*a*) Get the nose well down.
   (*b*) Release.
   (*c*) Think : " Can I land straight ahead without overshooting ? " If the answer is " yes," do so. If the answer is " no," immediately start a turn to one side, then make up your mind whether you can get in ahead with an " S " turn.

Only if you are quite sure that you have got plenty of height, do a circuit.

EXERCISE IX (C)

ADVICE TO INSTRUCTORS

1. It is essential that the pupil be able to cope without assistance should a cable break occur. Remember that, unlike those trained by the solo method, he has had no experience of hops, and so the first time that a break happens he is apt to be rather shaken.

2. Should you have a break at an early stage in the training, explain that there is nothing to be alarmed about and tell him what you are doing.

3. As soon as the pupil can do the take off and climb by himself the action in the event of a cable break should be explained to him. Then if one does happen he can get useful practice. If, however, he is nearly ready for solo and has not actually himself made a recovery from a real break it is essential that he be given some dummy ones before he goes solo.

4. Dummy breaks are best done by telling the winch or car driver, before the flight, to throttle back when the glider is at a certain height (say " at two spans " or whatever you want).

In side-by-side two-seater gliders it is not a good thing to simulate the break by pulling the release yourself as the pupil will see what you are doing.

5. When explaining the immediate action after the cable has broken talk about getting the nose well down ; do not say " Push the stick hard forward," otherwise the pupil may start to do a bunt if he has a cable break when flying fast.

6. There is always a temptation to whip around on a quick circuit from a low height instead of going straight ahead or doing an " S " turn. If you do this yourself when you have a real cable break, you cannot blame your pupil if he does the same thing.

7. This aspect of training tends to be neglected because of the time spent in retrieving the glider from the far end of the field, but the importance of practising cable breaks cannot be over-estimated.

8. If the pupil's first solo is going to be a high hop, dummy cable breaks will be excellent practice for this.

9. The pupil will learn nothing from this exercise unless he does all the flying himself.

10. Insist on the pupil keeping his hand on, or near, the release knob on every launch.

FIRST SOLO

EXERCISE X (A)

CONSIDERATIONS

1. A pupil learns most when he is flying solo ; he only becomes really confident in his own ability to fly when he knows that he can do so without the aid of an instructor. Therefore there are obvious advantages in allowing him to go solo as soon as he is fit to do so.

2. On the other hand, there is considerable risk in sending him solo before he is ready for it. The danger is not only one of physical damage to pupil and aircraft, but also the effect on his confidence if he flies badly.

3. It is clear from these two considerations, which are, to some extent, contradictory, that the instructor must exercise very careful judgment in the matter.

4. The standard required for the first solo is safety before polish. Two indifferent circuits sensibly corrected show airmanship ; two which happen to be right may be luck.

5. If the pupil is making the flight in a two-seater, the instructor should see that the straps in the empty cockpit are securely fastened and that any necessary ballast is attached. If the two-seater has tandem seating, no ballast

will normally be necessary for the C.G. requirements, but it may be desirable to fit some in order that the rate of descent when flown solo will not be very different from that dual. Side-by-side two-seaters usually require ballast for solo flying. If the amount installed is only just sufficient to bring the C.G. within the required range, the pupil will find the stability of the glider and its behaviour on the launch very different from that which he is used to; avoid this; a greater amount of ballast should be fitted, so that the flying characteristics of the glider are similar to those with the instructor aboard.

6. If the pupil is to be sent solo on a single-seater, the following differences in characteristics will have to be explained :—

(*a*) The position of the nose when gliding at the right speed.
(*b*) The noise, and the feel of the air on the pilot's face.
(*c*) The feel of the controls.
(*d*) The angle of glide and the rate of descent.
(*e*) The launching characteristics.
(*f*) The cockpit layout.

If the type has very different characteristics, the pupil will have a great deal to assimilate in one trip. As judgment of speed is the most important thing to get right, the pupil should do one or two high straight hops to demonstrate that he can fly the single-seater at the right speed. He can then be sent off on a circuit.

7. The first solo should be made under the easiest possible conditions, such that the pupil will get a good launch, and have the largest possible clear area for his landing. He should not have to contend with a rough or cross-wind or a dazzling sun.

8. The instructor should supervise his pupil's departure for his first solo flight, and give him just as much advice as is required by the circumstances, and no more.

EXERCISE X (B)

ADVICE TO INSTRUCTORS

1. The first solo always seems to be a big step to the pupil, but the instructor can do much to make this step appear in its proper proportion—simply a normal part of the training.

2. The instructor must base his decision as to when to send the pupil solo not only on his flying ability but on his health and mental outlook at the time. The pupil should not be told when the instructor has made his decision or at what future time he will be sent solo. The instructor should not allow the approach of the first solo to be turned into an event, or the pupil to feel that he is a guinea pig. Audiences, particularly those which include girl friends or relations, should be discouraged.

3. The pupil should not be asked whether he feels competent to go solo, but should be told that he is.

4. The first solo must be made immediately after a dual flight. Everything must be ready so that the man can be sent off with the minimum of delay.

5. The briefing before the first solo flight should be kept to an absolute minimum, and only those things which he will find different when flying solo should be mentioned.

6. If he is sent solo on the two-seater, practically no briefing is required, and he goes straight off on an ordinary circuit.

7. If a single-seater is to be used and if the first flight is to be a hop, the last flight in the two-seater should also have been a hop.

The following points should be made :—

(*a*) Attitude of the glider. Point out the different seating position in relation to the nose. With the pupil in the cockpit lift up the tail until the glider is in the correct gliding attitude.

(*b*) Explain in what way the noise and the airflow on his face will be different.

(*c*) See that he can work the controls comfortably and that he knows the position of the auxiliary controls.

(*d*) Explain in what way the launch will differ from those to which he is accustomed.

8. Ensure that the winch launch or auto-tow will go off without a hitch ; see that only competent people are used for signalling, etc.

9. The transition from two-seater to single-seater can be made easier if the instructor gets the pupil to fly the two-seater in such a way that some of the characteristics of the single-seater are reproduced. For example, if the two-seater is much quieter than the single-seater, the pupil will tend to fly the single-seater too slowly. But if he is made to fly the two-seater fast so that there is more noise, he will be more likely to fly the single-seater at the correct speed. This need only be done on the last two or three flights before solo.

10. If the pupil is being sent solo on a single-seater fitted with an A.S.I. it is vital to ensure that this is known to be working accurately. This should be checked by a stall made in the test flight.

11. It is common experience that instructors who really allow their pupils to fly on their own during dual instruction are the ones who get their pupils off first on successful solo flights.

FURTHER SOLO FLYING

EXERCISE XI (A)

CONSIDERATIONS

1. The whole aim in gliding training is to produce competent, safe pilots who are skilled in all aspects of soaring.

2. Dual training is only a part, although a very important part, of the pilot's training. It is the pilot's subsequent solo flying which will determine his ability as a pilot.

3. After a pilot has gone solo he still has a lot to learn. On one hand, if this part of his training is neglected he will not appreciate how much he does not know and will become over-confident ; while, on the other hand, if he is kept on too tight a rein, not only will he get bored, but also, because he has no practice in thinking things out for himself, he will be at a loss if his instructor is not there to look after him.

4. It is, therefore, necessary to strike a mean between these two extremes and gradually to lead the pilot to the stage where he is competent on his own. Discipline must not be relaxed, but it should be exercised less frequently. At the beginning of his solo flying the pupil should be told exactly what to do on each flight ; his flight should be watched and his faults pointed out to him. Later this becomes less necessary and by the time that the pilot is doing advanced soaring the " orders " become " advice." However, the instructor

must realise that he is in charge of all flying taking place from his field and if any bad or dangerous flying is done or any regulations broken, he must assert his authority to see that it does not happen again. If he does not stop this bad flying at once other pilots will follow suit and the whole standard will deteriorate rapidly.

5. Until the pupil has gained some experience he should be taken very slowly. Dual check flights should be given frequently, both to see that he is becoming proficient in what he is practising solo and also to make sure that he is not developing any bad habits. If the pupil has not flown for some time he should be given a dual check before he is allowed to go solo ; the same considerations apply if the conditions are different from those to which he is accustomed, e.g., strong winds.

6. The various exercises which the pupil will have to do in his training can be divided into four groups :—

A. Straightforward circuits. The pupil should continue to do these until he can do them competently and has got used to flying by himself.

B. Stalls, 360 degree turns, sideslipping and spot landings. Practice in these will add some variety to his flying while he is gaining more experience. The importance of plenty of practice in stalling cannot be overestimated.

C. Use of instruments, use of airbrakes, steep turns, slope soaring, thermal soaring, spinning, flying in strong winds, flying new types, aerotowing and bungey launching. Cross-country flying.

It is impossible to lay down any hard and fast rules for the order in which these exercises should be carried out because so much will depend on the types of aircraft available, the methods of launching, the weather and the site. But it should not be illogical and a new exercise, or the same one under difficult circumstances, should not be introduced until the pupil is proficient in the old. For example, until a pupil has done some slope soaring under easy conditions he should not be allowed to attempt it on a day when it is difficult. Nor should he be allowed to go across country until he has made several good local thermal flights.

It is often difficult to arrange solo spinning. If this cannot be done until late in the pupil's training he must be kept in practice by doing it dual. If aerotows are available there is no excuse for not doing these solo spins, and in any case no pilot should be allowed to do aerobatics or to enter cloud until he has done a number of spins solo.

D. Cloud flying, aerobatics.

7. It is inadvisable to lay down hard and fast rules for the number of hours or launches which a pupil has to do before he is allowed to progress to the next stage, as pupils vary so much in their ability. Minima can be set, but in practice these tend to become the normal and a pupil may be upset if after doing this number of flights he is not allowed to go on to the next stage. It is far better to have tests of proficiency, and for the instructor to decide on his own judgment of the pupil's flying and the way in which he performs these tests.

8. There is a tendency for the instructor, once he has got his pupils solo, to neglect them. This must be guarded against and a real interest taken in their progress, their flights must be watched carefully, and as well as pointing out faults the instructor should give praise when it is merited. This is particularly important with a slow pupil ; a little encouragement will help him a lot.

9. The following points should be watched in solo flying and dual checks :—

(*a*) Excessive use of rudder in turns.
(*b*) Tendency to fly more and more slowly.
(*c*) Failure to keep a good look out.
(*d*) Tendency to pull up too steeply at the beginning of a winch or auto-tow launch.
(*e*) Carelessness (see below).
(*f*) Overconfidence (see below).

10. Carelessness. A pilot may develop a careless attitude to flying as he gains some experience. This may not be due to overconfidence, which will be dealt with later, so much as laziness or an inability to criticise himself. This carelessness may show itself in the following ways.

(*a*) Slapdash cockpit check, omitting to check controls.
(*b*) Lack of effort to land in a suitable place (i.e., frequent landings on launching line).
(*c*) Taking off with a doubtfully clear run.
(*d*) Lack of care in handling gliders and equipment, in driving on the field, in giving signals, etc.
(*e*) Carelessness in attaching launching cables, by using wrong release.

These careless habits must not be allowed to develop.

11. Overconfidence. Overconfidence is a natural tendency with everyone, but it is particularly so with pupils who learn easily. Once this habit has been allowed to develop it is extremely difficult, and often unpleasant, to overcome. If the instructor can see its development in a pupil at the outset he can usually avoid trouble. Such a pupil should be given a good measure of fair criticism and difficult exercises to perform. Overconfidence may be inherent in the pupil's character, or its development may be due to watching flashy flying by other pilots (e.g., landings made very close to parked gliders, etc.).

The signs of overconfidence are numerous ; some are listed below :—

(*a*) Low turns.
(*b*) Tendency to fly slower and slower.
(*c*) Trying to cut things too fine—dangerous undershooting, when trying to land back at the launching point, or landing towards obstructions without room for a mistake.
(*d*) Reluctance to be briefed.
(*e*) Disobedience.
(*f*) Desire to try something new without having gained solid experience.
(*g*) Tendency to hand out advice.

SIDESLIPPING

EXERCISE XII (A)

CONSIDERATIONS

1. A glider is said to be sideslipping when its path of descent is at an angle to the heading of the nose.

2. The result of a sideslip is to increase the angle and rate of descent without a corresponding increase in forward speed ; this feature makes it a useful correction for overshooting.

3. The sideslip provides a method of counteracting the effects of drift over the ground; it is sometimes used for this purpose when landing out of wind.

4. The glider can be sideslipped while gliding straight or while turning, and both methods may be used as corrections for overshooting. The slipping turn, in which height is lost during the turn, is particularly useful when, during the approach, one finds oneself very close to the lee boundary of the field. In rare cases it may be used after deliberate overshooting to clear high obstacles on the lee boundary.

5. Sideslipping is an unnatural condition of flight ; both the lateral stability and the weathercock stability tend to prevent it. The lateral stability tries to take off the bank, while the weathercock stability tries to make the glider turn into the sideslip. So, to keep the glider in a sideslip the aileron control must be used to maintain the bank, and the opposite rudder used in an attempt to overcome the weathercock stability. The ailerons are usually powerful enough for their purpose, but on most gliders the rudder is comparatively weaker and so this necessitates the use of full rudder at a small angle of bank. If the bank is increased beyond this angle, insufficient rudder control will be available to keep straight.

6. During the sideslip the elevators are used for their normal function of controlling the position of the nose so far as pitching is concerned ; they cannot, however, prevent the nose from dropping towards the lower wing tip, as a result of yaw.

7. Much the same considerations apply to the slipping turn, which is simply one with insufficient rate of turn for the angle of bank.

However, in this case conditions are not quite so bad because the weathercock stability is being allowed to take effect to some extent by yawing the glider, and so less rudder is required to keep the nose up than in a straight sideslip. For this reason, on some types of gliders which can be held only in a very gentle straight slip, a slipping turn is a much more effective way of losing height.

8. If the usual gliding speed is to be maintained during a sideslip the position of the nose will be higher than in the normal glide.

9. Owing to the high lateral moment of inertia, the large span, and slow rate of roll of most gliders, the recovery from a sideslip takes some time. Allowance should be made for this and the sideslip should not be continued right down to the ground.

10. The introduction of air-brakes has provided a more simple method of regulating the approach, and sideslipping is in consequence less frequently employed. But the importance of sideslipping should not be forgotten, for, while it remains an essential manœuvre for gliders not equipped with air-brakes, it may also be used on gliders fitted with air-brakes to increase their effect.

11. In the air the sideslip will be demonstrated and practised by three typical examples : First at height, where it is simply an example of the use

of controls under sideslipping conditions ; secondly, as a slip into wind near the ground ; and, thirdly, as a slipping turn. The last two are given as practice for spot landings.

12. On some types of gliders once a slip has been started the rudder loads become reversed. It is important that this is understood by the pilot, as the necessity, when recovering from the slip, of applying a force to centralise the rudder is apt to be rather disconcerting.

EXERCISE XII (B)

AIR INSTRUCTION

1. **Effect of controls during sideslip**

Bank the glider and apply opposite rudder to prevent the nose from turning. Maintain the same speed ; the nose will be slightly higher than in the normal glide.

Keep the bank constant to maintain a steady rate of descent.

Note that the path of descent is at an angle to the heading of the nose.

To obtain a greater rate of descent, increase the angle of bank ; notice that more top rudder is needed to overcome the tendency to yaw. A limit is reached when full top rudder is applied ; if the bank is still further increased the rudder will be unable to prevent the nose from turning.

To recover, level the glider laterally and centralise the rudder at the same time getting the nose down to the normal gliding position.

2. **Slipping into wind**

Glide towards the field into wind. Bank the glider to left or right, at the same time swinging the nose in the opposite direction to allow the glider to continue descending into wind.

During the sideslip adjust the heading of the nose to keep the glider travelling on the right path.

To recover, level the glider laterally, swing the nose back into wind, and get the nose well down.

3. **The slipping turn**

Glide across wind and start the final turn into wind rather higher and closer in than you usually do. Increase the angle of bank and make the glider sideslip by putting on top rudder.

When facing into wind recover.

The rate of descent during the slipping turn will be rapid. If sufficient height has been lost before this turn has been completed it can be converted into a normal gliding turn. If the glider is till too high at the end of the slipping turn this can be changed into a straight sideslip.

EXERCISE XII (C)

ADVICE TO INSTRUCTORS

1. Although the sideslip at height is necessary for the pupil to learn how to use the controls most of the instruction should be given on the actual approach, where the effect of sideslip will be apparent to the pupil.

2. Explain that it is necessary to keep the ailerons applied, and why a sideslip differs from a turn in this respect.

3. A common fault is a tendency to lose speed during recovery, often resulting in a heavy landing. Emphasise the need to get the nose well down to maintain the gliding speed.

USE OF AIR BRAKES

EXERCISE XIII (A)

CONSIDERATIONS

1. The air brakes fitted to gliders are of two different kinds (*a*) Spoilers and (*b*) Dive brakes.

(*a*) Spoilers, which take the form of flaps fitted on the upper surface of the wing, are designed primarily as a means of increasing the rate of descent on the approach.

They have three effects :—

(i) They increase the drag and hence steepen the angle of glide.

(ii) They reduce the lift over a part of the wing, with the result that unless the angle of attack is increased the wing will produce less lift. The stalling speed is also increased.

(iii) They may produce a change of trim.

(*b*) Dive brakes. These normally consist of surfaces arranged to extend both above and below the wing. Unlike spoilers, which are not usually stressed for high speed flying, dive brakes are designed for this purpose. They were developed as a means of limiting the diving speed of a glider to a safe maximum, because, without brakes, a glider in a steep dive can reach such a high speed that very severe loads are imposed on the structure.

In addition, they are also used in the same way as spoilers as an approach control. Compared to spoilers they :—

(i) Produce a greater increase of drag, particularly at higher speeds.

(ii) Also reduce the lift over a part of the wing.

(iii) Are usually designed to produce no change of trim.

2. When flying with the dive brakes or spoilers shut, the air loads upon them are usually such that there is a tendency for them to open. To prevent this, spoilers are normally fitted with springs and dive brakes with some sort of lock. The springs on spoilers are normally strong enough to return the spoilers to the closed position when the pilot lets go of his control, but dive brakes are usually arranged to ride fully open once they have been unlocked.

3. Use of airbrakes on the approach. Control of the approach can be achieved by altering the flight path or the angle of glide. With the use of airbrakes the angle of glide can be varied to a considerable extent, and because of this a simple straight approach can be made without the complication of " S " turns or sideslips.

The basic technique is to make an approach with a long straight final glide into wind, which, if continued with the airbrakes closed, would result in an overshoot. The airbrakes are then opened in varying degree in order to make such adjustments to the angle of glide as may become necessary. Normally the approach will be made at a speed slightly greater than that used in a brakeless approach. However, if, particularly in the case of gliders fitted with dive brakes, it is found that the use of full airbrake would still result in an overshoot, the nose can be put further down and the path steepened without excessive speed building up.

If the final part of the approach and the hold off is made with the brakes fully open the following should be considered :—

(*a*) Since the approach is steeper the alteration in angle required to level out is greater than usual.
(*b*) Deceleration will be more rapid.
(*c*) The stalling speed will be slightly higher.
(*d*) The wind gradient effect will be more noticeable.

For these reasons, unless the final approach has been made at a fast speed, it is desirable to partly (or even completely) close the brakes while making the check and beginning of the hold off.

When actually holding off, any alteration in the position of the brakes will cause a marked alteration in the flight path unless the attitude of the glider is at the same time altered by moving the stick. An inexperienced pilot will find this difficult to do, and so for the first few landings he should be told to make the final part of the approach, the check, and the hold off with the airbrake lever in a constant position.

4. Use of dive-brakes at high speed.

The pilot should get used to the idea that dive brakes have been designed for his safety and that at any time when, through losing control in cloud or through bad aerobatics, there is a chance of his speed becoming high, he should open the brakes without hesitation. If he waits until the speed is nearly at the permitted maximum before starting to use the brakes, not only is there a risk of exceeding the permissible figure, but when the brakes are unlocked they will ride open with some violence.

EXERCISE XIII (B)

AIR INSTRUCTION

1. Do your final turn in such a position that you will make a long straight final approach, which, if you did not use the brakes, would result in an overshoot.

When you are sure you are going to overshoot, open the brakes to steepen the angle of glide. Keep the speed steady—slightly faster than the normal glide approach.

Use the brakes to control the approach.

When you get near the ground, close, or partly close, the brakes. Do not move the lever during the check, hold off and landing. When you are on the ground open the brakes fully.

EXERCISE XIII (C)

ADVICE TO INSTRUCTORS

1. On most gliders fitted with spoilers, if the lever is let go, the spoilers will shut. On the other hand, once dive brakes have been unlocked they will open fully if the pilot lets go of the lever.

Pupils should be instructed, therefore, that once they have started to use either spoilers or dive brakes on the approach, they must keep their hand on the lever continuously until they are actually on the ground.

2. To an aeroplane pilot the air brake control is similar to a throttle ; there is a tendency to " close the throttle " during the hold off, which will result in full brake being applied at an awkward moment. Point this out.

3. Past experience has shown that if the brakes ride open inadvertently, particularly on take off, the pilot may not notice this. He may even do a complete circuit without realising why he has had such a bad launch and comes down so quickly. This failure can be particularly dangerous if it occurs on aerotow.

The possibility of this happening should be pointed out to the pupil and he should be told that if anything feels wrong he should immediately check that the brakes are shut and locked.

4. The Air Instruction given is that appropriate for the pupil's first few landings using brakes. When he can do these satisfactorily he should be allowed (provided that the wind is not too strong) to do a few landings with the brakes fully open. Then he can be allowed to vary the amount of brake during the check and hold off. He must realise the importance of not getting too slow.

5. Once a pupil starts to use the air brakes sideslipping tends to be neglected. The ability to sideslip with the brakes open, particularly in a turn, is of considerable value when making an approach over obstructions into a small field.

TAKE OFF AND LANDING OUT OF WIND

EXERCISE XIV (A)

CONSIDERATIONS

1. Take off and landing out of wind may be necessary when the best landing run is at an angle to the wind, or when there are obstructions on the boundary or landing ground which limit the run into wind.

2. When an aircraft runs along the ground out of wind the following factors must be taken into consideration.

(*a*) The aircraft wants to weathercock into wind.

(*b*) The wind tends to blow the aircraft sideways. If, as is normally the case, there is friction between the skid or wheel and the ground, this will prevent the aircraft from moving sideways, and it will tend to blow over.

3. When the aircraft is flying out of wind, it moves sideways over the ground, and if it comes in contact with the ground the sideways movements will be checked and side strain will be imposed on wheel and skid. The essence of the whole problem is that the aircraft is pointing in one direction and either going, or trying to go, in another. Therefore, the aim in both take off and landing is, in the first place, to ensure that the aircraft is transferred cleanly and deliberately from the ground to air, and vice versa, and, in the second place, to see that before placing the wheel or skid firmly on the ground on landing, the aircraft is facing the direction in which it is travelling over the ground.

4. When sideslipping a glider is not travelling through the air in the direction in which it is pointing. This fact is of use in landing and taking off across wind, since by keeping the windward wing down the tendency to drift down-wind can be reduced.

5. Out of wind landings may be necessary because of the shape of the field or its approach, or because the pilot has not discovered that he is not into wind until he is close to the ground.

6. Having decided that an out of wind landing is necessary, he should pick a definite landing line. He can keep his aircraft on this line in two ways : either by keeping the nose to the windward side of the line, or by keeping his nose along the line and sideslipping the machine into wind.

7. If the approach is made with the wings level and the nose to windward, the drift will be very noticeable, and should the glider be landed travelling crab-wise, as it is, severe loads will be placed on the undercarriage. This can be avoided by yawing the machine by applying down-wind rudder so that at the moment of touchdown it is travelling in the direction in which it is pointing.

8. In the second method, of sideslipping, the aircraft can be landed without drift by keeping the heading of the aircraft on the landing line and maintaining a sideslip into wind. Owing to the large span and small wing tip clearance of most gliders a steep sideslip near the ground is impossible, and this method cannot eliminate much cross-wind drift. The first method is more satisfactory, but some judgment is required in swinging the nose the right amount at the right time, and it is easy to get confused. Furthermore, as the nose is swung down-wind, the windward wing will tend to rise and should the glider make contact with the ground with some drift with its windward wing up, its leeward wing may dig in and the machine turn over.

9. For these reasons, a compromise of the two techniques is the best.

EXERCISE XIV (B)

AIR INSTRUCTION

1. **Taking off across wind**

As the aircraft moves it will want to weathercock ; prevent this by down-wind rudder. When the wing tip holder lets go the windward wing will tend to rise ; prevent this, and try to keep the windward wing actually down. Keep the machine firmly on the ground until it has proper flying speed and then lift it cleanly into the air. During the launch keep the windward wing down to reduce drift and ensure that the cable is not dropped away to one side.

2. **Landings**

Select a landing path, and keep the machine tracking down it by keeping the nose heading into wind. During the check and hold off keep the windward wing down slightly. When flying at a suitable speed for landing swing the nose down-wind with the rudder to eliminate drift, keeping the windward wing still down a bit. Put the aircraft gently but firmly on the ground, and, still keeping the windward wing down, try to keep it running straight along the ground—it will want to weathercock into wind.

EXERCISE XIV (C)

ADVICE TO INSTRUCTORS

1. Pupils are very easily confused over this business, partly because they find very great difficulty in seeing any drift at all, and partly because they are often not quite sure whether they should attempt to turn and land into wind, or make an out of wind landing.

2. Make the distinction clear to them, and explain that, should they not find out that they are heading out of wind until close to the ground, it is better that they should land in the direction in which they are pointing rather than attempt a turn low down.