CLUB FLYING AND GLIDING

ADÈLE PARK

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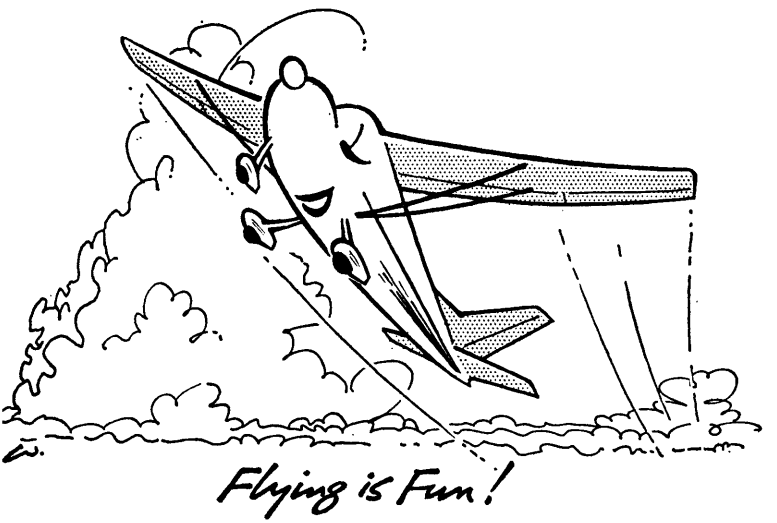
Introduction

PEOPLE in England still fly for fun, and the vital link between aircraft and pilot remains the flying club. You will find a number of these clubs scattered throughout the country, each possessing a distinct personality, although fundamentally similar in the matter of essentials. Every



club has a fleet of aircraft, hires them out at a set rate per hour to qualified pilots, and teaches beginners to fly. The Chief Flying Instructor (CFI) is in charge of all flying, and he and his assistants do the instructing.

There are always a number of people who are interested in joining a club and learning to fly. These would-be pilots

have queries which include the cost of flying, the skill involved, and many others. I intend to supply this information in the following chapters, and also give an idea of what you have to learn to become a pilot, besides providing a short cut to some practical experience for those already learning.

This book is written from one person's viewpoint—mine. I have been a member of various clubs at all stages of qualification. I was a student pilot when still too young to fly solo. I gained my private licence when I was seventeen years old, continuing to fly at several clubs and qualifying at the age of nineteen as a professional pilot with a commercial licence.

As for aviation being a man's world—I would say that a girl with a private licence is accepted as an equally good pilot by most men with a similar qualification, and is treated no differently from a man by her instructor or by the aerodrome authorities on any question pertaining to her flying responsibilities and skill. This cuts both ways. It is useless to land on the wrong runway and think that you need only smile at the controller to get away with it. But, on the other hand, your capabilities will be recognised and your opinion sought irrespective of your sex.

I find that some people instantly dismiss the possibility of learning to fly as being far too expensive for practical consideration. It would astound them if the numbers could ever be known of those who have learnt to fly and gone on to gain, in some cases, commercial licences, without having "visible means of support" as the phrase goes. By dint of doing half an hour's flying a week, and earning some free flying by doing small jobs on the airfield, many pilots began their flying careers. Flying is not beyond anyone's reach.

Joining a Flying Club

BEFORE joining a flying club there are several points to consider. Obviously it is most convenient to join one as near home as possible, but as there are a variety of clubs, it is best to join the one which suits your needs and finances best. First of all, do not confuse a flying club with a flying school. The latter is designed for training pilots up to professional standards. At some of these schools you can complete a course for a Private Pilot's Licence (PPL), but you will be given a professional-type training even for that licence. It is probably cheaper to go to a flying club.

The most efficient type of club is also the most expensive to fly at. It usually operates a seven-day week, has good club premises, modern aircraft and is ideal for a quick flying course or for hiring a reliable aircraft to take away for a day or a week. You know that the aircraft you have booked will be ready for you on time, fuelled up and all set to go. The only drawback of these clubs is that they are often a trifle tedious.

The club which has a variety of aircraft, old and modern types, is less efficient. Sometimes there is no full-time club secretary and the instructors have to catch up on the paperwork when the weather is bad. Bookings are a little uncertain as the club operates some older types of aircraft which are liable to go unserviceable at short notice. Liaison between club and hangar depends on Bill telling Charlie—when he next sees him—that someone has booked the Tiger for two o'clock so can he complete the propeller change by then? Such clubs, however, attract a wonderful mixture of members and there is never a dull moment.

Part-time clubs often began as a group of pilots owning an aircraft and then deciding to buy a second one and turn the group into a club. Their instructor does other work for a living so is only able to teach at week-ends and during summer evenings. The flying is cheap, but a student pilot needing instruction will obviously take longer to gain his PPL here than at a club operating full-time. The club house, if any, is usually a hut which is designed more to house the aircraft's spares than for the comfort of the members. These clubs, however, are a boon to the pilot with a PPL wishing to do a large number of hours as cheaply as possible. Once the club instructor has decided that you are to be trusted, he will let you fly the aircraft during the week when no one is there, provided that you can generally attend to its needs without assistance.

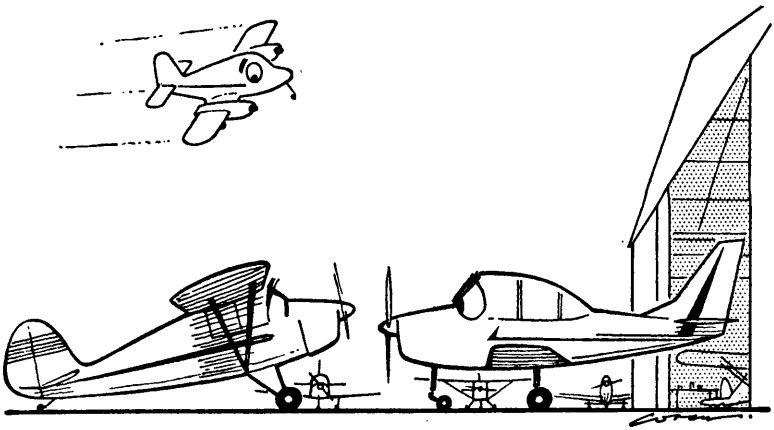
It is ideal, of course, to be a member of several clubs and use them as it suits you. Sometimes you want to be sure of having a comfortable modern aircraft waiting for you as booked; at other times you are not in a hurry and want to enjoy yourself, and there are days when it will benefit you financially to cover your hands with oil and dirt, and then take off for a few hours of cheap flying.

TYPES OF AIRCRAFT

Choosing a type of aircraft on which to learn basic flying is mainly a question of cash and personal preference. A few years ago, all basic training at flying clubs was carried out on British aircraft, the most usual being the Auster, Tiger Moth, and Chipmunk. Recently, flying clubs have been able to obtain and operate foreign light aircraft, so there is nowadays a far greater range to choose from.

Britain builds very few modern light aircraft, so that at most clubs the old-type basic trainer is British and the modern touring aircraft and new-style basic trainer is

American or from the Continent. One of the main differences between the old and new aircraft is that the newer types mostly have nose-wheel instead of tail-wheel undercarriages. An aircraft with a tail-wheel undercarriage sits on the ground nose high, in what is called its "three-point attitude." When it is flying, the tail is raised and the aircraft



Tail-wheel and nose-wheel differences

takes up its "flying attitude." A tricycle (nose-wheel) undercarriage makes the three-point and flying attitudes one and the same.

Another difference is that modern aircraft are much more comfortable, but despite their undoubted attractions of easy handling, cabin heaters, cigarette lighters and foam cushioning, my personal opinion is that it is better to learn to fly basically on the old-style tail-wheel trainer. It compells you to fly more accurately, and in doing so you acquire skill in handling the aircraft. If you can fly one of these aeroplanes really well, you will find the modern types extremely simple to fly. The ideal way is to gain your private licence on the

old-style trainer, then take your friends for a flight in the comfort of a modern aircraft.

STARTING TO FLY

I find that people who are interested in learning to fly usually ask much the same questions about it.

The first question is always one of cost. Initial expense comprises your flying club subscription which may range from two to four guineas; a medical examination by your own doctor (you arrange the fee with him) for the issue of a Student Pilot's Licence (SPL) which itself costs two pounds. Now we come to the actual cost of aircraft hire. Club aircraft, depending on the club and type of aircraft, cost between three pounds and seven pounds per hour to hire, and you have to do a minimum of forty hours flying to gain a PPL. All this sounds very expensive, but the cost can be broken down and spread over some time. You could start flying at the rate of half an hour a week, which is not costly and is a reasonable length of time for your first lessons. Later, when you begin doing cross-country flights, you will have to save up in order to do an hour and a half to two hours flying at a time.

When you have gained your PPL, you have to do a minimum of five hours a year to keep it valid. As the name implies, the flying must be on a private basis—you cannot charge passengers for taking them for flights, nor can you be paid to do a flight. That prerogative belongs to the holder of a Commercial Pilot's Licence.

As a private pilot, you may fly almost anywhere in Britain, using civil aerodromes. You may not fly in certain areas of controlled airspace, like the London Control Zone which surrounds London Airport, but on the whole controlled airspace does not prove much of a hindrance to

planning a cross-country flight. You may also take an aircraft abroad.

You will be taught to fly by qualified instructors at the flying club you join. You may be taught initially by an assistant instructor, but you will be sent on your first solo by the holder of a full instructor's rating. He will have a minimum total flying experience of 400 hours, including 200 hours' instructing experience, so you can have complete confidence in his judgement that you are safe to fly alone. Besides, he wants his aircraft back in one piece. Most student pilots solo after about nine hours instruction, the occasional genius gets away in five hours and some people can take as much as thirty hours. Instructors say that it makes no difference at all to your final skill as a pilot whether you solo early or late during training.

Flying an aircraft is not at all like driving a car. A good driver is not necessarily a good pilot and vice versa. I learnt to fly before learning to drive, and on occasions in the car I still try to pull the steering-wheel back to get the nose up! The use of speed in an aircraft and a car are completely different; so are the methods of control; in an aircraft the pilot is operating out of his element and can move in three dimensions; weather plays a major part in a flight. But the main difference is that you have to *think* about flying much more than you do about driving. When you have learnt to drive, conveying a car from A to B becomes merely a series of automatic reactions. However experienced a pilot, you cannot fly solely on your ability to handle the aircraft. Your brain has to be put wholly into the flight, governing your every action throughout.

If you want to own an aircraft, you will have to go into the question of cost very thoroughly. An aircraft can cost anything from a few hundred pounds to several thousand, depending on type and condition. Maintenance for aircraft

is compulsory. For an aircraft to fly, it must have a valid Certificate of Airworthiness (C of A). Private aircraft are run on a three-year C of A. When the C of A expires, the airframe is completely stripped down and inspected, parts are replaced or repaired and the airframe rebuilt. After the aircraft has been inspected by a representative of the Air Registration Board, a new C of A is issued. Every type of engine has a 'life' ranging from 600 to 1500 hours, after which it is not allowed to be used. The engine is traded in for a new or rebuilt engine. Club aircraft run on a two-year C of A, and aircraft used for commercial flying have the C of A renewed yearly. Apart from maintenance, the other main costs of owning an aircraft are those of fuel and hangarage, which can be expensive if you want to keep your aircraft somewhere near London. An aircraft does not have to be insured unless it is entered for a race.

Some pilots join together to form a group, buying and operating an aircraft between them. This works out well provided that all members are good pilots and no one prangs the aircraft, as they usually operate on a small budget which does not allow for extra maintenance costs.

THE STUDENT PILOT'S AND PRIVATE PILOT'S LICENCES

The Student Pilot's Licence is a stepping stone to the Private Pilot's Licence. Although you may take lessons with an instructor before you hold any type of pilot's licence, you are not allowed to fly solo unless you hold an SPL. You do not have to have any flying experience for the Ministry of Aviation to issue the licence but you need to be at least seventeen years old and to have passed a medical examination. Your flying club will supply you with the necessary application forms.

The student pilot can fly solo under the supervision of a qualified instructor for the purpose of gaining a PPL. He

may not carry passengers until he has gained his PPL. The requirements which he has to fulfil to gain that licence are as follows:

He must have a total flying experience of at least forty hours, consisting of a minimum of twelve hours dual (*i.e.*, flying with a qualified instructor), and ten hours solo. The remaining hours can be made up of either dual or solo.

Of the ten hours solo, three hours must be solo cross-country flying, completed within the six months before the date of application for the PPL. One cross-country flight must be over a triangular course, with the student pilot landing at the two intermediate aerodromes, one of which must be at least fifty nautical miles from his home aerodrome.

The student pilot's first solo, and his long solo cross-country are the two climaxes of his training.

After completing the flying experience necessary for his PPL, the student pilot has to do a short written examination at the flying club, and take a flying test. His examiner will probably be the club's CFI.

The length of time taken to gain a PPL depends on six contributory factors—money, weather, aircraft serviceability, your instructor, your aptitude, and the amount of spare time you have to devote to flying.

The Circuit

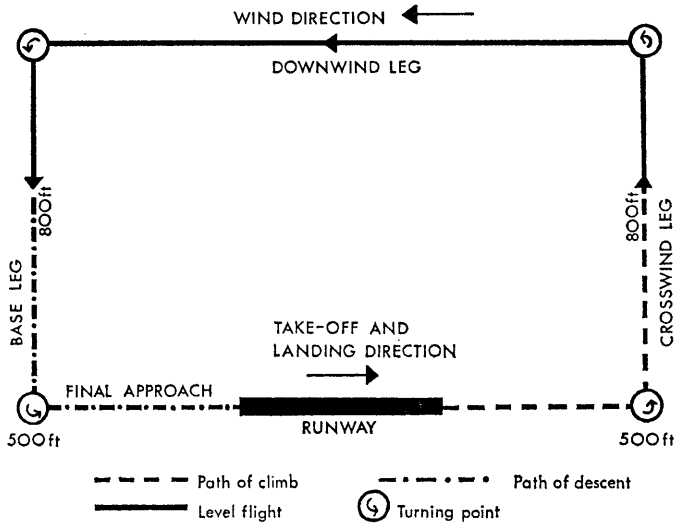
THE circuit is the aerial path round an airfield which is flown by aircraft practising take-offs and landings, and is also used by aircraft leaving or arriving at the airfield. I have chosen to explain the circuit because it is the root of basic flying and often perplexes the student pilot considerably. After learning to fly straight-and-level, to perform turns, climbs, and descents, to stall and to spin, the student then begins to do "circuits and bumps"—take-offs and landings. Often progress slows down at this stage as the circuit is difficult and has to be mastered. The student pilot's first solo consists of flying one circuit alone.

A brief explanation of speed is necessary here for the non-piloting reader. The subject is vast, but it must suffice that speed in the air has an almost entirely different significance from speed on the ground, where it is a matter of choice. In the air, such choice hardly exists, and a basic minimum speed is necessary to defy gravity. An aircraft is flown at laid-down speeds quoted for its type, which will give best and safest performance. A circuit in a DH Chipmunk would be flown at approximately the following speeds—take-off 55 knots, climb 70 knots, cruise 95 knots, and approach 65 knots.

A circuit is not a circle, as the name implies, but must be regarded as rectangular in shape, consisting of four ninety-degree turns (see diagram). It is flown at a height of 800 feet above the airfield. A normal circuit is left-handed, *i.e.*, all four turns are made to the left. Occasionally, this rule does not apply if a left-hand circuit from a certain runway takes the aircraft over a built-up area. In this case a right-hand

circuit is used and this is indicated in the signals square outside the control tower. When no mention of direction is made, the circuit is *always* left-handed.

As aircraft take off and land into wind, and the wind does not always blow from the same direction, each runway



LEFT-HAND CIRCUIT

has its own circuit. For example, an airfield having three runways will have six possible directions of take-off and, therefore, six circuits. Needless to say, only one is used at a time.

TAKE-OFF AND CLIMB

You begin by taxying your aircraft to the holding point at end of the runway in use. Come to a halt in a position from which you have a clear view of any aircraft coming in to land, as they have priority over you. Now make your cockpit check, and if the engine has not already been run up,

this must be done. When you are ready, check that no one is coming in to land and that the controller is giving you a green light. This signal means that you may taxy on to the runway and line up down its centre line. If you are using grass you can line up more accurately into wind. You can check the wind direction by observing the windsock. The wind rarely blows exactly down a runway. The controller may give you another green light, indicating permission for take-off.

Open up very smoothly to full throttle, keeping the stick back. Remember that only jet aircraft advance in a straight line under full power, and in your aircraft propeller torque will cause it to swing when full throttle is used. The best method of keeping straight is to apply rudder only when you feel the aircraft starting to veer off, using just enough to hold it in a straight line. When the aircraft has gathered a little speed, push the stick gently forward to raise the tail. Your aircraft is now in a flying attitude, and the wings, instead of the ground, are taking over the job of supporting the weight of the aircraft. When the airspeed indicator needle reaches the correct take-off speed, ease the stick back and the aircraft will come off the ground. Now, hold the aircraft parallel to the ground until the correct climbing speed is reached, when you can pull the stick back further and climb the aircraft away from the ground, maintaining that climbing speed.

You will probably find it easier to keep straight on take-off when you are flying an aircraft with a tricycle undercarriage. Most of them have a steerable nose-wheel, interlinked with the rudder, so that when you apply, for example, left rudder on take-off, the nose-wheel turns to the left as well. When you take off in such an aircraft, keep the stick or control wheel slightly forward until take-off speed is reached. An aircraft with a tricycle undercarriage has its

centre of gravity foward of the main wheels, so it is reluctant to leave the ground. Pull the control wheel backwards decisively for a clean lift-off, otherwise you will find yourself hopping down the runway like a kangaroo. Again, hold the aircraft parallel to the ground until the climbing speed is reached, and then begin to climb.

Now you are climbing at full throttle in a straight line from the runway. When you reach 300 feet, throttle the engine back slightly. If you have used flap on take-off, now is the time to raise it. You will find that you are having to keep a pressure on the stick to maintain the climb at the correct speed, because raising the flap has caused a trim change. The trimmer is a device which allows the aircraft to be flown according to the position of its centre of gravity, without a continuous pressure being kept on the stick to allow for nose or tail heaviness. You trimmed the aircraft for take-off—now re-trim it for the climb.

When you reach 500 feet, still climbing straight ahead, have a careful look round for other aircraft, push the stick forward a little so that the speed increases by five knots or so, then begin a climbing turn to the left, through ninety degrees.

CROSSWIND LEG

When you have turned to the left so that you are at right angles to your take-off path, ease the stick back a little to lose the extra five knots you needed for the turn, and continue to climb crosswind until you reach 800 feet. Now push the stick forward until the aircraft is level, neither climbing nor descending, then throttle back to cruising revolutions per minute (r.p.m.). The speed will build up to cruising speed, and you will find that the aircraft needs to be trimmed out once more. When the airfield appears to be behind your left wing-tip, have a careful look round, as you must do for

each and every turn, then do a level turn through ninety degrees to the left.

DOWNWIND LEG

When you look to the left, you will see that you are now flying parallel to the runway that you used for take-off, but in the opposite direction. As you took off facing into wind, you must now be heading downwind. At this stage make a cockpit check, correct your position relative to the airfield if necessary, and assess the air traffic situation.

Although you may be able to omit doing a downwind or landing check in certain light aircraft, it is advisable to be in the habit of doing one *whatever* aircraft you are flying to avoid unnecessary mishaps. Landing checks vary for the particular aircraft, being longer for larger and more complicated types of aircraft. A useful general check to remember is the R.A.F. landing check—BUMPFF—brakes, undercarriage, mixture, pitch, fuel, flaps.

At this stage have a look at the airfield and check the size of your circuit. If you are too close to the airfield, fly out a little to the right because you will otherwise have to turn very steeply to get in to land. If your circuit is too wide other pilots will cut inside your path. Either way, the downwind leg is the time to make any alterations.

Have a good look round to see what other aircraft are in the circuit. Note what aircraft are behind you but don't worry about them. Plan how to fit in with the ones ahead of you. For example, if you are following a Tiger Moth and there is the choice of runway or grass for landing, you can be certain that he will take the grass, so you can use the runway. If you want to land on the grass as well, and your speeds are higher than his, fly farther downwind and make a slightly larger circuit than he is doing so that he has a chance to land and taxy out of your way before you arrive

on the scene. If the aircraft ahead is faster than you, he will gain distance the whole time, so you need only follow him. Fitting in with other aircraft can be a worry at first, but when you have learnt to fly accurately and can put the aircraft exactly where you want it, a crowded circuit is no problem at all.

When the airfield lies behind your left wing-tip it is time to do another level ninety-degree turn to the left.

BASE LEG AND APPROACH

You are now flying crosswind again, and you are at the beginning of the approach and landing. While on base leg, you will decide when to throttle the engine back and begin the descent. Your judgement will be based on consideration of a number of factors such as the aircraft's glide, the load carried, the wind strength, distance to the airfield, obstructions on the approach path, amount of flap to be used, and if you intend to use any power during the approach.

You are at 800 feet on base leg, and you have decided that if you close the throttle completely now, you will reach the airfield without any further use of the engine. When you close the throttle, reduce speed to gliding speed then push the stick forward to lower the nose of the aircraft, thus preventing the speed from dropping any more. Re-trim the aircraft. Maintain the correct gliding speed for the aircraft. Lower flap as necessary beneath flap-limit speed. When the runway appears just ahead and parallel with the left wing, push the stick forward to increase the speed by five knots and make a gliding turn through ninety degrees to the left. As well as having a normal look round before beginning to turn, look out to the right of your aircraft to check that no one is flying a long final approach. When you have completed your turn you will be heading towards the runway facing into wind on what is called "final approach," more

simply known as "finals." Keep an eye on the tower for a green light, authorising landing. If you have judged your approach correctly you will continue to descend in a straight line at gliding speed, crossing the airfield boundary at the right height for a landing to be made.

There are two faults which you may make when judging an engine-off approach. Logically, you may either throttle the engine back too early or too late on base leg. The former results in undershooting, the latter in overshooting.

Undershooting

If you have throttled back too soon on base leg you will find yourself too low too far from the airfield. Do not try to "stretch the glide." The remedy for undershooting is simple —open the throttle. When the aircraft is either correctly positioned again or over the airfield boundary, you can close the throttle once more.

Overshooting

In this situation the aircraft comes in to land far too high. An *overshoot* is when the pilot decides not to land, opens up to full throttle and climbs away to make another circuit.

At first you will be taught to overshoot when you find yourself too high on finals, but when you have gained a little experience you are taught how to lose that extra height. If full flap has not already been used this will help. Full flap will steepen the angle of descent without a build-up of speed. You will remember that a little flap may be used on take-off. In that case it is used in order to increase the lift of the wings and shorten the take-off run. At greater flap angles than thirty degrees, the drag exceeds the lift gained, which is the effect that you want on the approach, especially if you can see at an early stage that you are overshooting.

You will find, however, that the best way of losing excess height is to sideslip the aircraft. To sideslip to the left, push the stick to the left and hold up the nose with right rudder. The aircraft will take up a cock-eyed angle and descend briskly. To come out of the sideslip, use right stick and left rudder. It is most important that the speed is right in a sideslip.

Sideslips are useful and can sometimes be employed for very crafty purposes. At a certain airfield near London, cricketers used to play on a pitch in a corner of the airfield at summer week-ends. Behind the pitch was a wood, and often the final approach would lie directly over the wood and the pitch. We used to sneak up hidden by the trees, and with the throttle closed so that there was the minimum of warning noise, suddenly appear between two groups of pine trees. A steep sideslip and we would fly between the wickets a few feet up while the cricketers scattered in all directions. They were very long-suffering and never complained, while most club pilots became aces at low side slips. The skill which I acquired in attempting to knock the bails off with the undercarriage has stood me in good stead ever since on more orthodox occasions.

If, for any reason, you decide not to continue with the approach and landing but overshoot and make another circuit, open up smoothly to full power and begin to climb at the recommended speed for a climb with flap. When you use full power the aircraft will yaw to one side as on take-off, so be ready to correct with rudder. Re-trim the aircraft and set the carburettor heat to "Cold." Do not raise the flaps until you have gained about 300 feet in height, then only raise them one stage at a time, and don't just bang the flap lever from fully down to fully up. Flap retraction causes an aircraft to sink, so it must be done gradually with enough height and speed to recover.

Speed on the Approach

The correct speed on the approach is vital. I have already mentioned the gliding speed of an aircraft, which is the specific speed quoted for the type of aircraft in a power-off descent, only varying according to whether flap or not is used. If therefore, you are making a glide approach, your gliding and approach speeds are one and the same. If you are flying an engine-assisted approach, *i.e.*, the throttle is not completely closed, your approach speed can be lower than for a glide approach.

Remember that the approach and stalling speeds are linked in that if the aircraft's stalling speed is increased or decreased, the approach speed must vary correspondingly. For instance, a heavily loaded aircraft will have a higher stalling speed than if it is lightly loaded, so adjust the approach speed accordingly. Flap and/or power reduce the stalling speed, so the approach can be flown a little slower under these conditions.

With all types of aeroplanes, a slow approach and landing speed is desirable, but bringing an aircraft in at less than the *correct* speed risks a stall and consequent crash on the approach. A too slow approach is dangerous. On the other hand, an approach which is too fast will cause you to overshoot the airfield.

You must control the speed throughout the approach (including in a sideslip), by fore-and-aft movement of the stick. If the speed is too low, push the stick forward to lower the nose so that the speed builds up once more. If the speed is too high, ease the stick back until the speed has dropped sufficiently. The maxim for you to remember is:

Control speed with stick and height with throttle.

If you find that your speed is very low indeed, you can *supplement* forward movement of the stick with throttle, but you cannot use throttle alone to gain speed. The use of

throttle regulates your rate of descent. It makes the descent path flatter and rectifies an undershoot.

Powered Approach

With many modern aircraft, the gliding angle is very steep with the engine throttled fully back and flap lowered. If the throttle is not completely closed on base leg the descent path can be made flatter and judgement of the approach becomes easier. The throttle can be adjusted during the approach to regulate the rate of descent and the approach can also be made more slowly. The throttle is not closed until the aircraft is over the airfield boundary. An important point is that the slipstream from the propeller makes the rudder and elevator more responsive than when the engine is throttled back and the propeller rotating more slowly.

LANDING

This is a skill which requires much patience to learn. As might be expected, it is a matter of judgement which comes with practice. Either a three-point landing (three-pointer) or a wheel landing (wheeler) can be made by an aircraft having a tail-wheel undercarriage.

Three-point Landing

When you cross the boundary of the airfield, or runway threshold, the aircraft is in a nose-down descending attitude. As you approach the ground, ease the stick gently back so that the nose of the aircraft comes up and its descending path is checked. Continue to ease the stick back until the aircraft is flying parallel to the ground six inches above it, in its three-point attitude. After "floating" for a little while, during which time you are easing the stick back as far as it will go, the speed decreases until the stalling speed is

reached when the aircraft will sink on to the ground touching with all three wheels simultaneously.

Easing the stick back to alter the aircraft's flight path from a descending to a level path parallel to the ground is called "levelling off." The first difficulty which you will encounter is judging the right moment to begin levelling off. To judge height accurately when within thirty feet or so of the ground, you must be looking in the right place at the right time. If you have made your approach at the correct speed, there is no further need to look at anything inside the cockpit when approaching the edge of the airfield. Look ahead and to one side of the nose of the aircraft, and begin judging your height by eye. I always glance quickly along the landing strip to make sure it is not obstructed in any way, then concentrate on looking at the ground close ahead of the aircraft. It is more difficult, incidentally, to judge your height above a hard runway than above grass.

If you level off too high above the ground, the aircraft will stall and drop heavily to the ground, perhaps damaging itself. If you ever find yourself in this position above the landing strip, open up to full throttle and overshoot. Sometimes the fall can be broken with a judicious amount of throttle and a landing made, but this should not be attempted by a beginner.

The other error you may make is to level off too late or not at all. The aircraft hits the ground on the main wheels at flying speed and bounces back into the air, where it will hang in a nose-high attitude a few feet up. Whenever you find yourself too high above the ground, forward movement of the stick must be avoided or must only be very small indeed. You can overshoot, or you can open up slightly on the throttle and ease the aircraft back near the ground to make a landing.

A mistake frequently made is to pull the stick back too

quickly when levelling off. The aircraft will climb away from the ground with the speed dropping. Some aeroplanes are very sensitive on the elevators during levelling off, and the stick must literally be brought back an inch at a time.

It does not matter what mistakes you make when learning to land—everyone has done appalling landings at some time —providing that you correct the mistake as soon as it occurs and try not to repeat it next time.

Some aircraft do float a good deal before touching down. An aircraft brought in to land too fast will always float. There is nothing to do but sit and wait for the speed to drop and the aircraft to touch down. If you attempt to put the aircraft down it will bounce. If you should ever find yourself approaching the end of the runway or airfield, still floating a few inches above the ground and too late to use full throttle and overshoot, raise the flaps. The aircraft will drop on to the ground at once. Some consider this poor airmanship, but in an emergency it is a life saver.

Wheel Landing

You will find that your instructor will tell you to do a wheel landing if there is a strong crosswind, or generally gusty wind conditions. More positive control is maintained than in a three-pointer, and the aircraft is less vulnerable to sudden gusts of wind. Fly your approach slightly faster than for a three-point landing, using plenty of power. Level the aircraft off very slightly so that it is flying just above the ground in a flying attitude. Forward pressure on the stick puts the main wheels on the ground, then close the throttle, still keeping the stick forward. As the speed decreases the tail will drop on to the ground and the stick can be brought back.

This landing uses more runway than does the three-pointer. The aircraft rolls in the minimum-drag attitude after touch-down and you cannot use the brakes until the

tail is down as the aircraft would nose over. If the aircraft has a long propeller you have to be careful not to put the stick too far forward, but on the other hand, if you are too tentative about putting the aircraft on to the ground and holding it there, it will bounce. The Chipmunk is one of the best training aircraft for doing wheelers.

Tricycle-Undercarriage Landing

You will find these aircraft easy to land after those with a tail-wheel undercarriage. You fly a normal approach and level off above ground. I usually ease the control wheel back as far as it will go until the aircraft stalls on to the main wheels, then I put the control wheel forward to pitch the aircraft on to the nose-wheel and apply the brakes. Another way is to level off, then apply slight forward pressure to the control wheel to touch first the mains, then the nose-wheel. The vital point to remember is *not* to touch the nose-wheel first as they are not designed to take the whole force of the aircraft pressing on them and will fold up. An aircraft with a tricycle undercarriage has less tendency to bounce on landing, but they can bounce if maltreated sufficiently!

AFTER LANDING

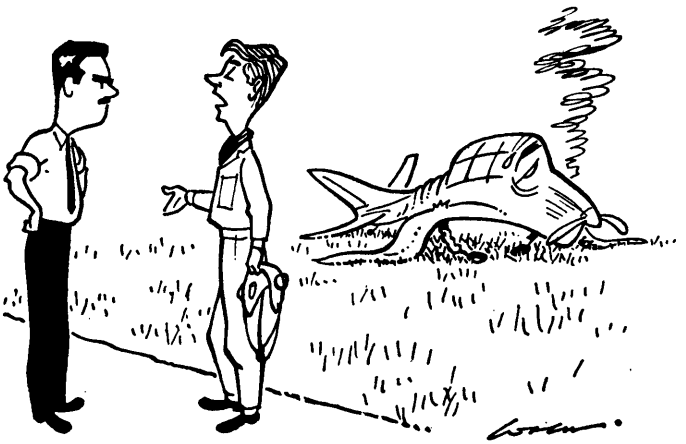
Keep the aircraft rolling straight using rudder, and either taxy to the end of the runway or turn off at an intersection. If you are on a grass airfield, turn left and come to a stand-still after landing, as aircraft following you will land on your right. Keep an eye on the control tower for any light signals, raise the flaps, set the carburettor heat to "Cold," and taxy in.

CONCLUSION

Learning to fly a good circuit is a challenge to the student pilot. Although the landing is an important and difficult part, a good circuit consists of more than a smooth touch-

down. One part of the circuit should blend into the next, an accurate rectangular path should be flown, with height and speed correct at all times. This is not achieved all at once, as is shown in the story of the R.A.F. instructor who was writing a progress report on one of his pupils. "His circuit," he wrote, "is a mixture of a cross-country and mild aerobatics."

Some airfields have local obstructions which involve a



"You think, then, that flying is not my bent?"

little additional circuit procedure. I once flew from an airfield where we had to check on final approach that no double-decker buses were coming along the road which crossed the end of the runway. Some near misses had been reported by the bus drivers, so we did this kerb drill at 500 feet.

If you can fly a good circuit from a medium-sized airfield in most weather and traffic conditions it will give you confidence. Some student pilots worry whether they will be able to do a good landing at a strange aerodrome at the end of a

cross-country flight. I learnt to fly when too young to fly solo, so I spent a good deal of time doing circuits with instructors. I have never regretted that time, especially when I began doing solo cross-country flights. If you can fly a good and accurate circuit at your home aerodrome, you will have little difficulty in doing a good circuit at a strange aerodrome.

Navigation

A SUCCESSFUL cross-country flight, in which the pilot flies efficiently from A to B, knowing where he is at any given moment and what time he will arrive at his destination, depends on three factors—pre-flight planning, course keeping, and map reading.

PRE-FLIGHT PLANNING

This is the basis of the flight, and its importance should never be underestimated. As much time as possible should be given to this aspect of the flight. A good deal of it can often be done the day before, if you are not going to have time to spare immediately before the flight.

First of all, look at the area on your map between your departure and destination aerodromes. Can you fly in a direct line between the aerodromes or must you divide the flight into two or more tracks to avoid controlled airspace or danger areas? Controlled airspace is marked on the kind of maps that you will use for map reading. Although you have to avoid control zones you can always fly underneath airways. Danger areas are marked on a separate map kept in the *U.K. Air Pilot.* If you cannot fly in a direct line from A to B, but must fly from A to a turning point and thence on to B, let the turning point be the most outstanding ground feature in that area. A large town, for example, a reservoir, or a distinctive convergence of railway lines are all suitable.

The next step is to look up your destination aerodrome in the *U.K. Air Pilot.* Every aerodrome has an up-to-date copy somewhere, usually in the control tower. This huge, loose-leaf reference book contains every piece of information

that anyone flying in the U.K. could possibly want, whether captain of an airliner or a Tiger Moth. It is divided into sections dealing with aerodromes, communications, weather, air traffic rules and so on, and the information is amended daily to be kept up to date. It is unnecessary for a private pilot to own a copy, but the *General Aviation Flight Guide* is most useful to have. This publication is composed of extracts from the *Air Pilot* which are of direct use to the private pilot. So, either in the *Air Pilot*, or the small edition of it, look up your destination in the aerodromes (AGA) section, and find the answers to the following questions:

1. Is the aerodrome open to visiting aircraft at the times you wish to arrive and depart? Remember that *Air Pilot* times are in G.M.T.
2. Must you ring up first to ask permission to land? The answer is "yes" if the aerodrome has "PPO" (Prior Permission Only) in the Remarks column. The telephone number is given.
3. Has the aerodrome the correct grade of fuel if you need to refuel the aircraft there?
4. Are there any special rules you must observe when approaching the airfield, joining the circuit, and landing? If the airfield is in a control zone, you must note the procedures in the RAC section applicable to it.
5. Are there hard runways or is it a grass field? This helps you to recognise the airfield when you do not know it.
6. Is there any other miscellaneous information that might be useful to know when using the aerodrome?
7. What is the frequency and call-sign if you want to call the aerodrome on the radio? You will find this in the COM section of the *Air Pilot*.

Having found all this information, you should make out a

little flight plan form for both ways, writing down the tracks, true airspeed, and distances. Personally, I do all the above-mentioned flight planning before I leave home, plus selecting alternate airfields and studying the route on the map very carefully as this saves valuable time. There are also variable factors to be considered in pre-flight planning, but these can only be dealt with just before departure.

Weather

The weather is, of course, the most variable factor of all. The pilot himself has finally to decide whether or not conditions are suitable for a cross-country flight and his decision will be based on weather reports and forecasts, his knowledge of the route and experience, To generalise, the weather should be forecast to be above certain limits for the whole period of time that you expect to be flying, and not be expected to deteriorate. If in doubt, it is best to ring Air Traffic Control at your destination, ask them what the weather is like and what it is forecast to do for the next few hours.

Altimeter Readings

When choosing a height at which to fly, you must allow for high ground; for flying underneath airways; for flying over active airfields at a minimum height of 2000 feet above aerodrome level (a.a.l.); for flying high enough to have the maximum chance of doing a safe forced landing, should the engine fail. If you do choose to fly above 3000 feet, it is advisable to fly according to the Quadrantal Height Rule (see *Aviation Law for the Private Pilot*, published by H.M.S.O.), but usually a cross-country can safely be planned below this height.

This brings us on to the QFE and QNH altimeter settings. The altimeter indicates height, as you will be told on your

first flying lesson. It is a pressure instrument, working on the principle that atmospheric pressure decreases with height. It has a subscale on the face of the instrument, graduated in millibars or inches of mercury, and a knob which, when moved, alters the subscale setting and the position of the hands of the instrument.

Suppose that you are sitting in the aircraft on an airfield that is 350 feet above mean sea level (a.m.s.l.). The hands of the altimeter are set to zero. The pressure setting against the reference line on the subscale is the pressure prevailing on the airfield at the time, and is called the QFE. If you take off, the altimeter will show your height above that airfield. If you then land at an airfield with an elevation of 500 feet, the altimeter will show 150 feet on touch-down.

To avoid doing complicated sums to find your actual height above high ground and other airfields when on a cross-country, you set the altimeter to the QNH. This is the mean sea level pressure. With the subscale set to the regional QNH, which you obtain from the controller or meteorologist, the altimeter will read 350 feet when on the ground at your home aerodrome, as that is the elevation of the airfield a.m.s.l. Accordingly, when you fly on your cross-country and you see there is a hill shown at a height of 900 feet, and you are at 2500 feet on the QNH, you know that you will clear it by 1600 feet. When you land at your destination, your altimeter will read the height of the airfield a.m.s.l. on touch-down. If you are using radio, the controller will give you the QFE so that you can reset your altimeter to show zero at touch-down.

Pre-flight Calculations

When you have decided at what height to fly, a.m.s.l., and have noted the QNH and the forecast wind for the selected altitude, complete your little flight plan form. At

this stage, your instructor will already have given you a verbal explanation of the triangle of velocities, which basic calculation is the fundamental of cross-country flying. The triangle of velocities can be worked out by scale drawing, mathematical calculation (trigonometry) or by using a navigational computer. The latter method is the usual one employed. You work out your true course by allowing for the amount the wind is going to drift you off your track. You then allow for magnetic variation. You find your groundspeed and work out the time the flight is going to take you. A head or tail wind will decrease or increase your groundspeed respectively, but will not give much drift. A wind on the beam will give a large amount of drift but will not have much effect on your groundspeed.

Fuel Requirements

You must now calculate how much fuel you will need. Allow time for a circuit, flight to your destination, flight on to your alternate aerodrome, and another circuit. You should also have a minimum of half an hour's fuel reserve in addition to the foregoing requirements. Using an aircraft with a limited range, it may be necessary to make an intermediate stop to refuel if the flight is long. Always play safe and have too much fuel rather than too little.

Final Preparations

Check that you have not forgotten anything—maps, computer, other navigational equipment, notebook, pencils, fuel carnet, and landing card. Tell the controller where you are going and when you expect to be back, and then you are ready for the most important check of all. See that the aircraft has full fuel tanks and check the oil level.

COURSE KEEPING

It is difficult to fly at a constant course, height, and airspeed, which are very necessary for accurate navigation, while simultaneously map reading and keeping a flight log. Using a computer under such conditions involves a minor juggling act, and so most pilots tend to forget about the flight log and keep the computer under the sandwiches on the back shelf of the cockpit. They concentrate on course keeping and map reading alone, but navigation inevitably loses precision and guesswork creeps in.

The flight log should consist of a stiff-backed notebook, in which all the pre-flight calculations are written out. Note the time of departure, *i.e.*, the time the aircraft begins to taxy out. When you note the set course time, add the calculated flight time to obtain the estimated time of arrival (ETA) at your destination. If you are a student, set course over your home airfield having climbed to cruising height. When more experienced, climb away on course, allowing time for the climb. Other times to note in the flight log are times over intermediate landmarks and the actual time of arrival at your destination. Putting time against distance on the back of your computer, you can check if your actual and estimated groundspeeds agree, and can revise the ETA if necessary. Note in the log if you alter course, stating new course and time of alteration.

As I have already said, when you are flying the aircraft yourself it is difficult to keep a flight log. It is good for your navigation if, at some time, you can obtain the use of an automatic pilot or friend (the former is often more accurate) to fly the aircraft for you at a steady course, height, and airspeed, while you do all the actual navigation and direct the flight. You can concentrate purely on the navigation and when you have both to fly the aircraft and navigate for yourself, you will find that you are doing it better

because your understanding of navigation will have improved.

MAP READING

This is a fascinating skill to acquire, and like all other skills an apparently effortless performance is based on hard work and experience. The private pilot will use mainly a half-million scale aeronautical chart, and for precise detail a quarter-inch scale map. The former is designed especially for aerial map reading, and shows only the features which stand out when viewed from the air. The quarter-inch is an Ordnance Survey map, with air information overprinted. Whatever maps you use, always check whether the heights shown are in feet or metres.

Map reading is similar to detection in many ways. You have to use your eyes objectively, that is, notice what you see and draw the correct conclusions. It is vital to keep an open mind when map reading—a preconceived idea may literally lead you astray. For instance, don't assume that the town you see ahead is X, because it lies roughly in the direction in which you expect X to be. X must be identified by the path of the river through it, the junction of the railway and the airfield on its western side. Only then, when it has proved its identity, can you use the fact that it is X on which to base further calculations. If you had been wrong in your initial assumption and you had not bothered to check on its distinguishing points, your next set of calculations would inevitably have been wrong and you would be all set to lose yourself.

From the air, certain ground features stand out more than others. Roads, apart from motorways, are useless for navigation purposes in a well-populated country, and can therefore be disregarded. Railways, however, are excellent for map

reading, except when they tend to disappear in the conglomeration of a built-up area. In the countryside they are most useful. Some which are still marked on maps are now disused, but the path of a former railway line is still clearly visible from the air for many years after the removal of the track. The remaining bridges and cuttings are additional checks that it was once a line. Reservoirs and big rivers are also clearly visible. Smaller rivers and streams, while marked on maps, are unreliable checkpoints as they are sometimes so small as to be invisible or have merely dried up. Trees, however, often grow on the banks of a stream, and remain to mark its course when it has dried up. Hills and ridges lose their prominence when seen from above, but are excellent for navigation when seen at a distance. Coastlines are first class for pinpointing position. Woods can be quickly cut down, so do not place reliance on seeing small ones or identifying them by shape. New suburbs alter the shape of a town. Always fold the map to show just the area you require, and hold it so that it points the way you are going, *i.e.*, when flying south hold it upside down.

Map reading ties in with time keeping. If you have worked out your ETA at a certain ground feature, you know what time to begin looking for it. Personally, I mark off the track in six-minute intervals. Six minutes is one-tenth of an hour, so if the estimated groundspeed is 87 knots, the aircraft will cover 8·7 nautical miles in six minutes. Before leaving, I mark the track with a little pencil line at intervals of 8·7 miles. I then know more or less when I should see the various landmarks, and know very soon if the estimated groundspeed is accurate. Revised ETAs can then be worked out.

Unless the visibility is exceptionally bad, or you are flying very low, once you know where you are over the ground directly beneath, concentrate on what lies ahead. For instance, it is very necessary to know the identity of the town

below, but once it has been positively and indubitably identified, don't waste any more time looking at it. When you leave the town behind you, what matters is that you are heading in the right direction, so see that the next landmark is appearing where it should be relative to your heading.

Always map read right up to your destination aerodrome, and let the aerodrome prove its identity to you before you accept that it is your destination. Many pilots (myself included), have lost themselves by seeing what they think is their destination while some way off, tossing the map down and flying straight to it, to find that they were mistaken. In fact, spotting an airfield, especially one without hard runways, is difficult until you have the knack.

When map reading in an aircraft without radio aids, you cannot afford to slack off for a moment. Although it is a full-time occupation it is a most interesting one, and considerably improves your eyesight and powers of perception.

BECOMING LOST

The first time you are lost in the air can be alarming. When you are more experienced, and have lost and found yourself a couple of times, it will not worry you so much when you are viewing miles of unknown countryside. It is worse if you have passengers with you, and worst of all if you have an examiner on board as these gentlemen have a habit of asking for "our present position, please" and demanding an answer. So as well as finding your position you have to put forward a convincing line of bluff in the meantime.

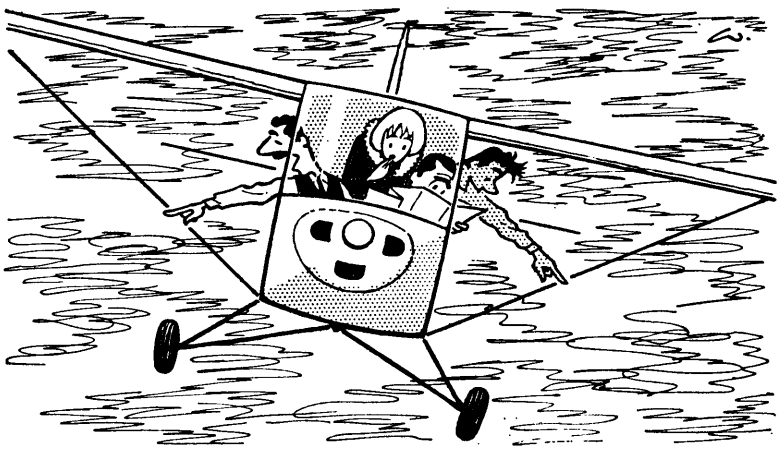
The first rule to observe: *Do not panic.*

The second: Check how much fuel you have left. This will give you the amount of time you have to find your destination aerodrome or another airfield at which to land. The advantage of starting with full tanks can now be seen.

The third: Stay on course and never fly round in circles.

If you have been flying a steady course and not wandering off it, turn on to your reciprocal heading, *i.e.*, fly back in the direction from which you have come. Continue to the last landmark that you definitely identified, then work out a corrected course to your destination, allowing for the inaccuracy discovered in the previous course.

Sometimes it is quicker to fly to the nearest "line feature" and find your position on it. Line features are railway lines,



It is worse if you have passengers with you . . .

coastlines, big rivers and long ridges of hills. For example, it is easy to get lost over East Anglia. There are so many disused airfields that they are very confusing, and there are few significant ground features. If you become lost in this area, the quickest method to find a position from which to proceed is to turn to a heading of 090 degrees (due east) and fly to the coastline. You can always find your exact position quickly on any coastline, and can plan a new course from there. You can follow a railway line to a well-

defined town or junction of lines. If you fly to a ridge of hills, take careful note of their height. If you fly along a line feature, keep it on your left.

Control zones are an additional hazard if you are lost flying in the vicinity of one. The golden rule here is to fly in the opposite direction until you have found yourself again. For instance, if your flight was planned to go along the northern side of the London Control Zone from west to east, and you became lost, turning on to a heading of due north will take you away from the zone at right angles, and out of possible trouble. London Radar would have you on the screen anyway as an unidentified aircraft and be able to trace you to your destination, so it is no good thinking that no one will notice if you trespass on the edge of the zone. Always, if you suspect you are drifting into a control zone, fly immediately away from it. It may inconvenience you at the time, but not so much as being fined in court later for disrupting air traffic.

At all times it is vital to be aware of height. It is so easy, especially in poor visibility, to come down below a safe height to have a look at the ground. I remember such an occasion occuring to me when I was fairly experienced. I was alone, and had decided to fly to a railway line and follow it. The weather was so bad that I should not have been airborne. As I turned on to a heading to fly towards the railway I remembered that earlier in the week I had been reading a set of accident reports, and the phrase, "aircraft hit high ground," had occurred frequently. I looked at my map, and saw that a hill of 950 feet was marked as being three miles from my present position but the mist blotted it from my sight. I had come down to 700 feet to have a closer look round. I climbed to a safe height rapidly. That sort of mistake is fatal, and so easy to make.

If the aircraft is equipped with radio and/or navigation

aids, a new position can be found very quickly. In fact, if you are flying such an aircraft you should not be lost in the first place.

FUEL AGAIN

On many training aircraft, there is either one fuel tank or two tanks which feed simultaneously into the engine. In either event, there is only one on-off cock. When you have gained a PPL and are taking passengers with you, you may decide to fly a bigger aircraft. You will naturally check how much fuel is carried and the consumption, but you may find that it is necessary to change from one tank to another in flight. To make a smooth change-over, it is necessary to "run the tanks through" when you start the engine before setting off, to ensure there are no air bubbles in the pipelines. If you switch to another tank in flight, and an airlock occurs, fuel starvation and engine failure follow.

Supposing that you are going to fly an aircraft which has two wing tanks. You could select the *left* tank for starting the engine, then after the engine has started change the fuel selector to the *right* tank. Warm the engine and run it up on the *right* tank, then switch back to the *left* before taxying out. When you subsequently change from left to right tank while flying, any air bubbles will have gone from the pipelines and the fuel will flow through. One point to remember—do not change tanks *immediately* before take-off, just in case an airlock occurs.

In flight, do not place a hundred per cent reliance on the fuel gauges. Note the time and change tanks when you estimate that nearly all the contents of one tank have been used.

REACHING YOUR DESTINATION

Fly over the airfield at about 2000 feet, keeping a good look-out for other aircraft. Check the landing direction, and

the circuit direction, and note any other signals displayed on the signals square. Before you begin to descend and join the circuit, plan your line of approach while you have a good view of the entire field. Then descend to 800 feet above aerodrome level on the dead side of the circuit. If you are using the QNH, 800 feet a.a.l. will equal a reading of 800 feet plus aerodrome elevation. If a left-hand circuit is being flown, descend to the right of the active runway. Join the circuit crosswind.

When you have landed, taxi in carefully, avoiding any marshy bits of ground and boundary markers in unexpected places. Either put the aircraft neatly standing into wind out of everyone's way, or if a man comes to marshal you in, leave the aircraft where he directs you. Often he will ask if you require fuel, and if so will take you right up to the pumps. Always supervise refuelling yourself so that the right grade of fuel goes in, check that the caps are replaced tightly, don't forget to check the oil and don't forget to retrieve your fuel carnet.

The first thing that you should do after leaving the aircraft, is to check in with the aerodrome controller. Even if a friend rushes out to greet you, send him in advance to buy you a cup of tea while you check in.

Before you leave, remember to check out with the controller, giving him the name of your destination aerodrome.

CONCLUSION

Cross-country flying is the most useful aspect of flying, and the student pilot will discover that there is a great deal of skill involved in it. The satisfaction of making a successful flight, in which you have been on track for the entire time and have arrived on ETA, makes you very happy and all the effort well worth while.

Every private pilot has had an "epic" cross-country at

some time or other, often just after gaining a PPL when you are apt to think very highly of yourself. These epics usually only damage your self-esteem. Some pilots come home by train and some with the tanks filled up with petrol from the local garage. I have suffered the embarrassment of walking into an aerodrome control room and saying, "Good afternoon—where am I?" But the best epic that I heard about was of the pilot who made a ninety-degree track error over 100 miles, and had the shock of finding himself at Biggin Hill, Kent, when he had set out to fly to Wolverhampton, Staffs. I expect it took him a long time to live it down at his flying club.

Aspects of Private Flying

PASSENGERS

WHEN the newly qualified private pilot has received his licence, he begins a tentative search for his first passenger. He does not tell this person that he has never before taken a passenger with him, but assumes a nonchalant air as if he had been passenger-flying for years. To help the newly qualified pilot to keep that air of nonchalance, here are a few hints on taking passengers for a flight in a light aircraft.

First of all, it is wiser to choose an aircraft with side-by-side seating. However much you like the Chipmunk or Tiger Moth, it is better to have your passenger under your eye in case he fidgets in the cockpit, blocking the movement of the controls or accidentally knocking switches off. This situation is nearly impossible to deal with if you are seated in separate cockpits.

Some light aircraft are difficult to enter with ease and dignity, and especially in the case of large or elderly passengers you may have to enlist the help of a friend to push while you pull the unfortunate victim aboard. Seat your passengers according to weight so that the balance of the aircraft is correct. Generally speaking, put the heaviest one in the front seat beside you and the lighter ones in the rear seats. Make sure that they all know how to operate the quick release on their harnesses or lapstraps. Demonstrate how to open and shut the doors before securing them.

If you are taking someone up for their first flight, it is enough to fly one large circuit of the airfield. Fly as smoothly as you can and do as few turns as possible. The mere sensation of being airborne is sufficient to satisfy the "first-flight" passenger without any additional sensations being provided

by your handling of the aircraft. The advantage of flying a large circuit round the airfield is that if the passenger doesn't like flying or feels sick, you can land within a few minutes. For more experienced passengers, twenty minutes to half an hour suffices as a local joyride, unless you are flying to another airfield and landing there.

I always aim to give a passenger a smooth, uneventful flight that he will remember with pleasure. If it has been his very first flight, I want him to have received a good impression of flying so that he wants to do more. Alarming a passenger by doing steep turns, sideslips, and aerobatics achieves nothing—he will certainly not want to fly with you again. I break this rule only if I have a passenger who is offensively convinced that there is "nothing to it". A single steep turn, with plenty of "g," forcibly changes his ideas.

Never take a passenger on any flight that you feel may involve the slightest risk to anyone or anything. Either fly alone or take a fellow-pilot who can appreciate the risk.

Dealing with passengers is a matter of common sense and patience. They expect you to answer all their questions and maintain a flow of small talk even on finals and while landing the aircraft. They like to take photographs and do their best to entangle you in the camera strap. They try to shift their position. Always keep your hand on the throttle as it is most vulnerable to being knocked open or closed. The only deterrent, which keeps passengers silent and awed for the entire flight, is if you are using radio, and there is a loudspeaker in the cabin roof so that they can hear what is being said. Listening to chit-chat between you and the controller never fails to impress them in my experience.

My favourite passengers are the exponents of a great aerial sport—parachutists. When you climb into the aircraft to fly it for parachutists, you find that busy hands have removed all the doors, and sometimes passenger seats as

well. They scramble aboard in all their heavy equipment and arrange themselves in the cockpit, pushing aside the passenger safety-harnesses. As soon as you have gained a little height, they are out of the door, riding on the wings, undercarriage, or other unusual travelling positions. Parachutists are rarely pilots, and treat the aircraft purely as a "platform." You have to remember this as you manoeuvre the aircraft under their directions so that speed, height, and position are correct for their exit.

I always marvel that a man wearing two bulky parachutes can climb out of the cockpit into the tearing blast of the slipstream, and then perch on the undercarriage wheel or struts with such apparent agility. They seem to manage effortlessly, and stay perched like this over a sheer drop of several thousand feet until the right moment arrives to let go of the aircraft and begin to fall. From my limited parachuting experience, I find that I am as clumsy as a bear when fully equipped to jump. I prefer not to linger on the outer portions of the aircraft as I feel decidedly insecure in such a position. But the sensation of tumbling earthwards through space is glorious and exhilarating each time.

CONVERSIONS

As soon as the average club pilot with a PPL thinks he understands one type of aircraft, he transfers his attentions to another. In other words, most PPL holders are not content to fly one type of aircraft but like to do conversions on to others.

Conversions are straightforward provided they are done methodically. Order and method are necessary because apart from remembering whether the aircraft has or hasn't flaps and/or a retractable undercarriage, every type of aircraft handles differently and all have the various knobs and switches in different places.

This latter trait can be most annoying. It is the fashion nowadays, when designing a cockpit layout for a modern light aircraft, to hide as many items as possible so that the pilot may spend a diverting hour or two playing hunt-the-starter-button. New hiding places are always being devised, but most frequently any switch that is important is either buried under the front seat or secreted in the roof. But the idea that it is thus impossible to knock off the switches accidentally is unfounded. I once turned off the master switch of an aircraft with no difficulty, having mistaken it for the seat readjustment knob, as both were located underneath the seat. I was flying with a Belgian pilot, who began to shout at me in a mixture of French and Flemish. I ignored his unintelligible cries and kept very calm (still trying without success to move my seat) until I noticed that both electric fuel gauges were registering zero, when I realised at once what I had done and what the Belgian was trying to impart to me.

In addition to knowing where everything in the cockpit is placed, it is as well to learn by heart the various speeds—take-off, climbing, cruising, stalling, and approach. Then come the cockpit checks. These are especially important in bigger aircraft. If you know all the drills, or have a list so that you can read them off, it helps very much when you do not know the aircraft.

A check-out on to a club aircraft with an instructor usually entails a stall at a safe height, a couple of circuits and an overshoot. The instructor will tell you all you need to know about the aircraft as you fly. If you are flying an aircraft for the first time alone, you must find out all you need to know beforehand. It is a wise precaution to fly at a fairly light all-up weight to make handling easy, and to choose good weather conditions. Then you can concentrate on managing the aircraft, and do not have to deal with gusting crosswinds or other additional complications.

Landing an aircraft with a tricycle undercarriage rarely presents any problem. If you are to level off correctly in an aircraft with a tail-wheel undercarriage, you must know the correct angle of the nose relative to the ground in the three-point attitude. This must be noted when you are sitting in the aircraft on the ground taxying out.

Twin-engined Aircraft

These require a certain amount of knowledge if they are to be operated safely, and if an engine fails you have to be quick in dealing with the situation. These two points apply especially to twins that are not very powerful and are normally flown single-handed (without a co-pilot).

I shall not forget my first solo in a twin. This particular aircraft, at the time, was temperamental and seemed to enjoy discomfiting its operators. Frequently one engine would start but the other would refuse to follow suit. A vigorous hand-swinging session would begin, the urgency of the situation being increased by the noisy sound of the other engine impatiently ticking over. Sometimes the undercarriage would only partly come down, and I believe one engine actually expired on a cross-Channel trip. The aircraft, however, bore a charmed life and has been the cause of acute worry and embarrassment to more than one pilot. On the day of my first solo in it, the brakes failed completely and the chief engineer told me before the flight that the starboard engine was showing a distressing tendency to stop when throttled right back. I flew for one uneasy circuit, and had an awkward time taxying in with no brakes and the necessity of keeping the starboard engine running fast.

This aircraft, in common with many twins with tail-wheel undercarriages, was hard to manage on take-off. Having two engines, there was double the swing and it was very difficult to keep straight. I soon stopped taking off on

the runway as I found it too narrow. I used the grass area instead. I developed a method of take-off which I now use, and although it has its flaws I find it avoids any hair-raising moments.

This aircraft swung to the right. My method, therefore, was to start the take-off run with the stick hard back, opening up the throttles unevenly, working the starboard lever forward slightly ahead of the port. This had the effect of pulling the aircraft to the left and counteracting the swing. I supplemented this with left rudder and a touch of brake (if it was working). When the aircraft had gathered some speed I would have full power on both engines and start putting the stick forward. The moment the tail leaves the ground you are dependent on rudder control to correct swing, and to have rudder control you must have sufficient speed and slipstream over the control surfaces. That is why I would not put the stick forward until the aircraft had gained that vital speed.

The aircraft with a tricycle undercarriage and a steerable nose-wheel is easy to keep straight on take-off, as application of rudder also turns the nose-wheel to correct for swing. An aircraft with a non-steerable nose-wheel and differential braking on the main wheels requires another technique. It is advisable to use a few notches of brake, so that when the aircraft is running straight this has no effect, but application of rudder to keep straight also applies the brake on the appropriate main wheel to pull the aircraft round.

The knowledge required to fly a twin is principally a knowledge of the aircraft's systems. For example, the left engine fails. It may drive the generator which operates the undercarriage lowering system. It is no use to wonder if it does or does not, you must *know*. And you must know where the emergency lowering system is and how it operates. Supposing that the flight continues using increased power on the

remaining engine. This, naturally, causes the fuel consumption to rise on that engine. How do you operate the cross-feed to pump the fuel from the left engine's tanks into those of the right engine? Again you must know without hesitation.

Asymmetric flying, that is flying a twin on one engine, is easy or difficult depending on how powerful the remaining engine is, how the aircraft is loaded and what devices there are to help with single-engined flying. Every twin has a single-engine safety speed, below which the speed must not be allowed to drop under asymmetric power conditions. If this does occur, the aircraft will turn over, out of control. Engine failure on take-off and single-engined landings, therefore, are critical. In the latter case the approach must be judged exactly right, as the aircraft will probably have insufficient power on one engine to overshoot with flaps and undercarriage down. I have made this sound as if engine failure is an everyday occurrence. It is not, but it is vital to be capable of dealing with it safely, should it happen to you.

The holder of a PPL may fly any aircraft below a certain weight limit, single or twin-engined according to whether he has Group A or Group B on his licence. When you hold a commercial licence, the individual type of aircraft has to be stamped on your licence before you can fly it professionally. A conversion consists of sufficient flying experience on a particular type, a written examination and a flying test. By the time this has been completed, you know a great deal about that type of aircraft. Although I had flown the same types of light aircraft on my PPL, I did not realise how superficial my knowledge was of them until I put them on my commercial licence.

AEROBATICS

Private pilots who fly merely because they wish to progress from A to B are seldom interested in aerobatics, but

the enthusiast who flies for love of flying and aeroplanes is usually keen to try them. Aerobatics are not obligatory for the PPL, you can choose for yourself whether you wish to do them or not. A session of aerobatics every now and then is great fun. Although it makes your own efforts seem elementary, a good aerobatic display such as the annual Lockheed International Aerobatic Competition at Coventry, is thrilling to watch. If you ever have the chance of a flight with one of the aerobatic aces, take it. He will begin turning the aircraft upside down long before you consider that you have reached a safe height, but it will be done so smoothly and competently that watching the control tower revolving round the nose of the aircraft will seem quite natural.

When you begin to learn to do aerobatics, it is wise to keep the sessions short until you are used to the sensations, because you may feel a little shaken up afterwards if you do too much. Tiger Moths, Chipmunks and some Austers are the normal aerobatic aircraft.

The preliminaries to a session are to choose an area outside controlled airspace, over open countryside, climb to a safe height (all manoeuvres should terminate at a minimum of 3000 feet above ground level), do a cockpit check, and complete a 360-degree turn between each manoeuvre to ensure that there are no other aircraft in the vicinity. In the Chipmunk it is especially important to check that the brakes are fully off as this affects full rudder travel. (The Tiger Moth has no brakes). It is sensible to wear goggles, even in a closed aircraft, to prevent dirt from the cockpit floor getting into your eyes.

The loop is the simplest manoeuvre of all, and the Tiger Moth is the simplest aircraft in which to do it. Put her into a dive to gain speed, easing back slightly on the throttle. At 95–100 knots apply full throttle, bringing the stick back firmly and gently, keeping straight with rudder. As you

turn upside down, the stick should be as far back as it will go. Put your head back and watch for the horizon to appear upside down. Then close the throttle, keeping the stick back as the Tiger goes over the top into a dive. Ease the stick forward and then back to recover from the dive, finally reopening the throttle.

There are a few points to be remembered about doing a loop. You must keep straight on rudder throughout. The initial dive must be straight. When you apply full throttle to begin the loop the Tiger Moth will swing to the right. You will correct with left rudder, but if you are slow in taking off this rudder when closing the throttle at the top of the loop, she will swing to the left. If you have looped perfectly straight, as you make the dive afterwards, you will hit the slipstream which you left when entering the loop. The aircraft gives a little shudder.

In a correctly executed loop, and in certain other aerobatic manoeuvres, positive loading is maintained throughout. Although the aircraft turns upside down during the evolution, it is still flying under normal flight conditions, the weight of the aircraft being borne as usual by the top surface of the wing. A loop is like swinging a bucket of water round so that when the bucket is upside down the water does not fall out. Although the pilot should certainly be wearing a safety-harness as a precaution, he will not need it because at no time will he feel himself leaving the seat and falling out of the aeroplane.

If you pull the stick back too quickly when entering the loop you will feel the centrifugal force pushing you hard down in your seat, the loop will feel uncomfortable and you will be straining the aircraft unnecessarily. If you do not pull the stick back quickly enough, the aircraft will lose too much speed when approaching the top of the loop and will stall upside down. The bucket has been swung too slowly—and the water

falls out. You will feel yourself parting company with the seat, your weight being taken instead by the safety-harness. Still keeping the stick fully back, the nose will finally drop and the aircraft will go over into a dive, unstalling itself.

In manoeuvres such as slow rolls and inverted gliding, when the aircraft is upside down, it is actually flying inverted and is under reversed loading. The weight of the aircraft is borne by what is normally the underside of the wing and the pilot is held in the aircraft solely by his safety-harness. Hanging upside down is an uncomfortable sensation for more than a short period, especially in an open aircraft. The golden rule is to do up your harness so tightly that you feel you cannot stir hand or foot, because you will always find that there is some slack in your harness when you turn upside down.

The slow roll is a difficult manoeuvre to do correctly and requires endless practice. When the aircraft is on its side the controls change functions, the nose being kept up with rudder and the aircraft being kept straight with elevator. When it is fully upside down forward stick is necessary to keep the nose up. Smooth co-ordination of these changes is the hard part of a good slow roll. Inverted gliding consists of turning the aircraft upside down, closing the throttle and putting it into a glide. The engine will stop under reversed loading because the fuel supply will cease to function properly. A few engines are specially adapted to run when inverted, and in these cases level flight can be maintained. Otherwise only a glide is possible.

You should pick a point ahead of you at which to aim for each manoeuvre, so that afterwards you know if you have looped or rolled straight. It is also advisable to check your position fairly frequently, or choose to do aerobatics near an unmistakable ground feature, as after ten or twelve loops it is easy to lose your sense of direction.

USING RADIO

The R/T Licence (Flight Radiotelephony Operator's Licence) is becoming essential for the private pilot. A great many light aircraft and aerodromes are equipped to use VHF R/T so there is plenty of opportunity to use the licence. Using R/T in the circuit means that the controller will advise you if you are clear to take off or land and give you any necessary information. On cross-country flights you can call up aerodromes en route for radio bearings and obtain weather information. When you reach your destination the controller will tell you the runway in use, surface wind, and QFE. You save time by only having to do a partial circuit or merely a straight-in approach instead of flying over the airfield to check landing direction and then doing a full circuit.

To obtain an R/T licence you have to go along to the Ministry of Aviation and take both a written and practical test. A student pilot may use the radio without an R/T licence while training for his PPL, but it is sensible to obtain the licence as soon as possible. The reason is that in the test the radio procedure has to be straight out of the book, and in practice it is considerably shortened. While it is easy to cut down calls, it is not so easy to remember to step them up to full length merely for the one occasion of the test.

To pass the test you must have a thorough knowledge of the H.M.S.O. publication, *Radiotelephony Procedure*. The written paper is not difficult if you know the booklet well, and also have learnt a little about radio waves. For the practical test, all the R/T phrases are in the booklet, as well as sample calls which include those for an entire airways flight. It is a good idea to run through these with an instructor or a friend who has taken the test, before you attempt it yourself. Pay special attention to learning the emergency procedures.

In the practical test you are shut in a box like a telephone-kiosk. Your "flight plan" is put in front of you. For simulated horror, the test is unique. You are supposed to be the captain of a twin-engined aircraft flying from London Airport along a certain route. The imaginary flight to which you are subjected makes you want either a couple of aspirins or the chance to bale out. As soon as you are "airborne" the calamities begin. Your aircraft ices up, but you deal with that successfully. Someone using your frequency puts through a Mayday distress call and you are forced to listen to him and his troubles for a considerable length of time. As soon as he has finished your aircraft catches fire (too late to melt the ice), and an engine stops. You make a lengthy distress call on the frequency that you are using at the time, then find that it has failed. Undaunted, you begin the call all over again on the distress frequency. It is acknowledged, but so much time has passed that the fire has long since gone out. You continue to fly, heading towards the nearest airfield, on one engine. At that stage you discover that the fuel tanks are leaking. . . .

The test is designed to see if you can literally talk your way through any emergency which may occur, and it certainly covers everything.

Some of the airways procedures that you learn for the test you will not use again, unless you become a professional pilot and gain an Instrument Rating.

Although you can cut down calls, there are certain ones which should never be shortened. Whenever a controller gives you an altimeter setting, always repeat it back in case you heard it incorrectly. For example, if you join a circuit downwind and the controller gives you "QFE 998," repeat back "QFE 998," and do not just respond with the famous R/T word – "Roger." This is for safety reasons. If you are approaching an airfield and relying on your altimeter to

show you your height above the airfield, as you would be if descending through cloud, the wrong pressure setting on your altimeter could cause you to hit the ground with height still indicated on the instrument. If the subscale on your altimeter is graduated in inches of mercury, ask the controller for pressure settings in inches instead of millibars.

Before making a call, decide exactly what you are going to say, then you will not hold up other pilots if the frequency is busy. You should know more or less what to expect in reply from the controller. For instance, if you were doing circuits and called downwind, the controller would say, "Roger, call turning finals" or something similar. But if you do not hear properly or understand the reply, ask the controller to repeat his message and go on repeating it until you do understand. If you want any information, or a special clearance of any sort, never be afraid to ask for it. The controller is there to help you.

Although the controller is a great help in a crowded circuit, do not neglect to keep a good look-out yourself for other aircraft. When he gives you permission to land or take off, double check that it is clear to do so, as the final responsibility for avoiding collision with other aircraft rests with you in visual weather conditions. If a controller advises for a climb in a certain direction after take-off, always check that it will take you clear of any high ground in the area. If you will not clear the ground by what you consider to be a sufficient margin, refuse the clearance and ask for a better one.

Having an R/T licence means that you can fly into aerodromes where the use of radio is obligatory, so more places are open for you to visit.

VOR

VOR is a radio aid to navigation. Many light aircraft in this country are now equipped with this aid and there are enough VOR stations to make it useful to the club pilot. Once VOR is understood, it is found to be a relatively simple aid to use, and can be used for position checks and flying on a selected track to or from a VOR station.

VOR stands for Very High Frequency Omni-Directional Radio Range. A VOR station can be compared with the hub of a wheel with spokes, in this case radio spokes, radiating from it. There are 360 of them and they are called *radials*. They are numbered from 001 to 360° Magnetic in the direction in which they point, *i.e.*, the 080 radial points towards 080° (M).

The actual aircraft equipment varies according to make, but will consist, in some form or other, of a VHF receiver with either variable or crystal-controlled tuning, and an indicator unit.

To receive the signal from a VOR station it is necessary to tune in to the frequency of the required station and identify the subsequent call-sign which is usually transmitted in morse every thirty seconds.

The indicator has three parts:

1. *The course selector*. This may either be a 360° dial with a needle which can be moved by a knob to select the desired radial, or the selected radial may appear in a window, in the form of digits.

2. *The sense indicator*. This consists of a needle which can point against the word "To" or "From" or remain in a neutral position. It indicates, depending on the radial set

up on the course selector, whether you are flying towards or away from the station. If it remains in the neutral position you are either not receiving signals or the aircraft is 80° from the selected radial or its reciprocal. For example, if the course selector indicates 180°, the sense indicator will remain neutral if you are on any radial between 080°–100° (M) or 260°–280° (M) of the station.

3. *The deviation indicator.* Imagine a circular instrument divided in half by a vertical line down the centre. The *left* half of the instrument is coloured *blue* and the *right* half *yellow*. There is a vertical indicator needle. For example, if the aircraft is on a heading of 160° (M) and the course selector is pointing to 160°, the deviation needle will be central as the aircraft is on the selected radial. Supposing, however, the aircraft drifts to the *left* of the radial, the deviation needle will swing to the *right* into the *yellow* part of the dial. To regain the radial, *follow* the needle and turn to the *right*. When the needle is central once more the aircraft will be back on the radial.

The deviation needle works on the principle that the whole area to the *right* of the selected radial is considered *blue*, and the area to the *left* of the selected radial *yellow*. The needle will be central when the aircraft is on the selected radial, but will point to the colour of the area in which the aircraft is placed if it is off the radial. The needle is accurate to within two or three degrees either side of the chosen radial.

Before reading any further, you should, with a pencil and paper, work out for yourself as much as I have already explained. When you have grasped it thoroughly, read through and work the following examples:

Example 1. You are heading towards Dover, positioned roughly to the north-west. You wish to home on to Dover

VOR station on a magnetic track of 090°. You select the frequency, tune in to the station and identify the call-sign. (In this case it is 117·7 Mc/s, DVR – · · · · · – · – ·.) You select 090° on the course selector. The sense indicator points at "To." The deviation needle shows full *yellow* deflection. You are, therefore, flying west of the station but to the left of the pre-selected radial. You are heading roughly in the same direction as the selected radial, therefore *follow* the needle. Turn right on to a heading of 180° (M) to intercept the 090° radial at right angles. When you are within about ten degrees of the radial the deviation needle will start to centralise. Start a gradual turn to the left on to 090° (M). When you are straight and level on that heading look at the deviation needle. If it is central you are on the radial. If it shows *blue* deflection you are in the *blue* sector to the *right* of the radial. The needle points to the *blue* half of the dial, which is the *left* half, so turn *left*. Vice versa if in the *yellow* sector. The deviation needle will show full deflection when seven to ten degrees away from the selected radial.

Allowance for drift must be made in the usual manner. The rule is: when the course is about the same as the chosen radial, turn *towards* the deviation needle for track correction; but if you are flying in approximately the opposite direction from the selected radial, turn *away* from the needle for track correction.

We will now presume that you are approaching the station on the selected radial. VORs have an area similar to an M.F. Radio Range's Cone of Silence, but the VOR cone is marked by the instability of the indicator needles. The width of the cone depends on altitude, but a width of two nautical miles at 5000 feet can be taken as an approximate guide. As you enter the cone above the station the "To" "From" needle moves wildly from one to the other until settling down to show "From" when leaving the cone. The deviation needle

will flick from full *yellow* deflection to full *blue* deflection until resuming its central position when leaving the cone. As you fly away from the station, still on the 090° radial, the same rules apply. For track correction *follow* the needle.

Example 2. You wish to check your position by obtaining a bearing from a VOR station. Tune in and identify the station. Rotate the course selector until the sense indicator shows "From", and the deviation needle is centred. The bearing on the course selector is the aircraft's *magnetic* bearing from the station within five degrees either way. To obtain the *true* bearing, the magnetic variation at the VOR station is added or subtracted depending on whether it is easterly or westerly. When plotted this will give a position line for the time at which the bearing was taken. To obtain a fix using a bearing from a second station, the two bearings should cross at as near right angles as possible for the greatest accuracy.

Details of VOR stations, frequencies, call-signs, hours of availability, maximum range, and altitude can be found in the *U.K. Air Pilot.* Like all VHF transmissions, range will increase with altitude and be approximately 100 nautical miles at 5000 feet. One big advantage of VOR is that it is not much affected by static or thunderstorm activity.

Finally, a word of warning. When you are experimenting with a VOR set in an aircraft, don't be oblivious to what is going on outside! Keep a good look-out all the time.

More Advanced Features

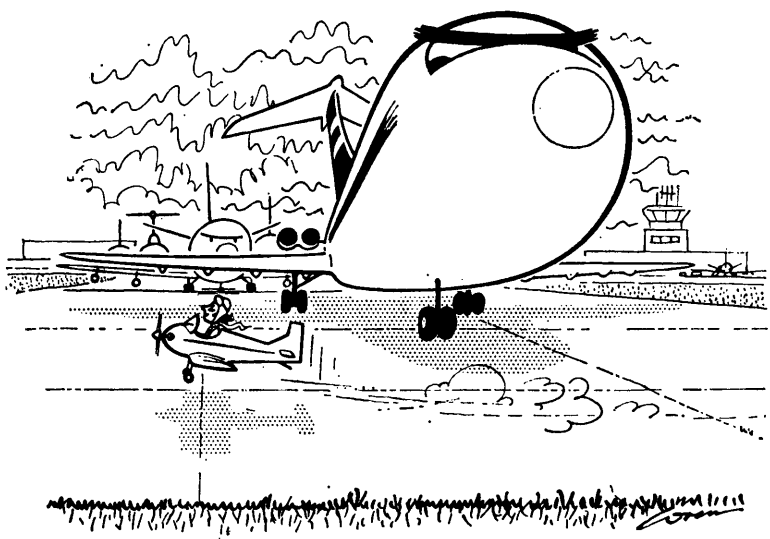
FLYING INTO LARGE AIRPORTS

IT IS unlikely that you will take a light aircraft into London (Heathrow) Airport, but there are other large airports which are open to light aircraft in good weather conditions and are worth a visit.

Before embarking on the trip make the normal preparations for a cross-country flight, taking all possible information about the airport from the *Air Pilot*. Check that your aircraft's radio is working and has the necessary frequencies. Then ring Air Traffic Control to ask if you may fly in, telling them the call-sign of your aircraft, where you are coming from and at what time. They will tell you if you are to approach on any particular route and which R/T frequencies to use. At some airports you will have to call initially on the approach frequency then change to tower frequency; at other airports they will accept you on the tower frequency alone. At all events it is wise to have everything made absolutely clear over the telephone before setting off.

If no specific instructions have been given about when and where to call initially on the R/T, give the controller a call when you are an estimated flying time of ten minutes away from the airport. Sometimes you have to wait a little before you can get a word in on the R/T if the frequency is busy. State your position, heading (*e.g.*, approaching the airport from the south), and ETA. The controller may either say, "Call field in sight," in which case you do so, or he may straightway give you circuit-joining instructions. Be prepared to write these down as they are shot at you, repeating back pressure settings.

When the airport is in sight you will have to work out, in relation to your compass heading, which is the runway in use. When you are closer you will see the numbers painted on the threshold of the runway. Adjust your circuit to comply with instructions. At large airports, where most aircraft are on scheduled passenger flights, there is not much of a circuit because departing aircraft climb away on course and arriving aircraft fly only a partial circuit. Training aircraft only will be doing complete circuits. You will be cleared to join downwind or base leg for a right- or left-hand circuit, or the controller may bring you in on a straight-in approach, depending on the direction you are coming from. Be sure to report your position accurately and remember your landing checks.



Landing a small aircraft on a long runway is a matter of common sense

Landing a small aircraft on a long runway is a matter of common sense. I always aim to land just short of an intersection so that I can remove the aircraft quickly from the runway, leaving it clear for the aircraft behind me on finals. The intersection to choose is the nearest one to the apron. If you get confused as to which taxy track to take to reach the apron, ask the controller for taxying instructions. If he tells you to follow another aircraft beware of its slipstream.

Once you are on the apron the marshaller will take control of your progress, complete with bats to direct you into your parking spot. It is a good idea to learn the signals in advance as it avoids inspired guesswork. He will direct you in with a kind of careless precision and you can ask him where to check in. Then you can arrange for fuel, customs, a meal at the restaurant or whatever you have come for.

Before departure, arrange with the controller whether you will turn right or left after take-off to put yourself on track for your destination. This is called a "right-hand turn-out" or "left-hand turn-out."

When you are using a large airport alongside airliners, whether jet- or piston-engined, it is very important to avoid taxying behind them when their engines are running, regardless of whether they are moving or at a standstill. The efflux of a jet engine is dangerous, and with your own engine running you cannot hear if a piston-engined airliner is running up its engines or not. If it is, and you taxy behind it, the slipstream will overturn you in two seconds. It is also important not to take off or land close behind an airliner, because especially on a calm day a slipstream can "hang" invisible in the air some distance behind the aircraft which caused it.

Apart from these little hazards, flying into a large airport is most enjoyable and adds to your accomplishment as a pilot.

INSTRUMENT FLYING

There is always talk of a few hours' instrument flying experience being made part of the syllabus for a PPL, but as yet it remains an extra to basic training. The reason for including it would be for accident prevention. One of the most common causes of fatal light aircraft accidents is inability on the part of the pilot to fly on instruments when caught out in bad weather, and subsequently spinning out of cloud.

When flying on instruments, you must trust your instruments and not your senses, for it is placing trust in the latter that leads the inexperienced instrument pilot into difficulties. When you are flying straight-and-level according to your instruments, your senses often insist that you are doing a steep turn. If you give way to them and begin to correct the imaginary turn you will soon be in a nasty position. I know that I spent my first few lessons just learning to ignore my senses and believe my instruments. It is not until you have achieved that state that you can learn to fly solely on instruments. Cloud conditions are simulated in an aircraft by setting up amber screens in the cockpit. The pupil wears blue goggles. The instruments appear clearly in front of you, but the screens appear solid black so that you cannot see outside the cockpit. Your instructor keeps a look-out for other aircraft.

Learning to fly on instruments is like learning to fly all over again. You begin by flying straight-and-level on a steady heading on the directional gyro, then you learn to make accurate turns on to other headings. Climbing and descending are done from one altitude to another at a set rate, either holding a heading or simultaneously turning on to a heading.

Handling has to be so precise and if you let your concentration slide for a moment the aircraft wanders off heading

or maybe the nose drops. If you were flying visually you would correct automatically, but on instruments you have first to work out quickly from the instrument indications what the aircraft is doing, then correct deftly and accurately.

When you are competent on "full panel" you transfer to "limited panel" instrument flying. The artificial horizon and directional gyro are covered up with a screening card so that you are flying principally on the turn-and-slip indicator and compass which is harder. The reason for this is that it is possible to "topple" the gyro in an artificial horizon or directional gyro instrument, thus rendering it useless, by exceeding the limits of the instrument in roll or pitch. You must be able to fly safely on the remaining instruments until the gyro re-erects. You might, for example, find yourself reduced to flying on limited panel when tossing around inside a cumulo-nimbus cloud.

The last part to learn of basic instrument flying is recovery from unusual attitudes on limited panel. The instructor tosses the aircraft around to confuse you, then tells you to take over when the aircraft is in an incipiently dangerous position. The most usual positions are steep turns, spiral dives with the speed building up alarmingly, and the point of a stall with a wing dropping.

If you are competent at the instrument flying that I have mentioned, you should be able to deal with being caught out in poor weather conditions. If you fly into cloud you will be able to do a 180-degree turn to fly out of it or you will be able to climb through it and come out on top. There is, however, an old pilots' saying about flying on top of solid eight-eighths cloud—"If in doubt, *never* come down to have a look." In other words, never descend blind through solid cloud as it might go down to ground level, and you cannot tell if it does or does not. Either descend visually through a

gap, or use your radio to obtain aid (radar positioning, for example) for the descent.

Instrument flying links up with radio aids and communications. Obviously club aircraft are not equipped like airliners, but good ordinary two-way VHF R/T with a range of useful frequencies brings to the reach of the private pilot an aid to flying in poor or dangerous weather conditions. This aid is ground radar. If you call up an aerodrome with radar unit the radar controller can find your present position and bring you accurately into that aerodrome on radar. On your part, all you must have is R/T on the appropriate frequency and the ability to do exactly what the radar controller tells you—turn right on to this heading, turn left on to that heading, descend at so many feet per minute . . . it is all basic instrument flying.

Private pilots can obtain the Instrument Rating, details of which can be found in the H.M.S.O. publication, *The Student Pilot's & Private Pilot's Licences,* but they very rarely do so. The cost of the flying test alone (fifty pounds per attempt in a Ministry DH Dove) might put you off, and unless you own or have the use of an aircraft with all the necessary radio equipment, the rating is no use to you. Being unable to obtain an Instrument Rating is no reason, however, not to be a proficient instrument pilot. During the winter, when flying activities are curtailed, it is a good idea to do some ground training on the simulator, or Link trainer which is remarkably realistic and does improve your instrument flying.

Sporting Activities

THERE are certain rallies which take place every year, mostly on the Continent. I believe that they are good fun, but costly if you do not own an aircraft, as the price of hiring a suitable aircraft for a length of time is high.

Club competitions, for members holding PPLs, are not expensive and can be very amusing. The most usual trials of skill are spot landing, aerobatic and navigation contests. But not all the sports are competitive, as you will see from the following description of a typical inter-club activity.

BREAKFAST PATROLS

These are diabolical inventions in which every kind of major or minor annoyance may occur, and are much patronised by newly qualified pilots. Experienced pilots wait to read about them in the newspaper afterwards. The idea is that the defending airfield notifies neighbouring airfields and flying clubs that it is holding a patrol on a certain morning between 9 and 9.30 A.M. and invites them to take part. Visiting aircraft, or attackers, must approach the defending airfield within the stated times and between certain heights, usually 1000–2000 feet, until they are within one-mile radius of the field when they are "home" and can land in peace. The defending airfield puts up every available aircraft to patrol the area, their job being to read the registrations of as many incoming aircraft as they can catch. Any attacker whose registration is not taken is entitled to a free breakfast when he lands.

What usually happens is this. You get up at 6 A.M. and anxiously peer out of your window to see what the weather

is like. Nine times out of ten it has a menacing aspect. In case it improves you dress and hurry off to the airfield to join the other pilots, whose tempers are not improved by early rising. You find that your aircraft is at the back of the hangar and three others have to be brought out before it can be moved. The tanks are empty and the refueller has not yet arrived. It begins to rain; the patrol is obviously "off", so you decide to have breakfast. As soon as your breakfast is put in front of you the weather miraculously clears and the patrol is "on" again. All pilots are called for immediate briefing. As a defender you are allocated an area to patrol. The organiser pleads with everyone not to collide, fly low or chase attackers within the one-mile radius of the airfield. Nobody listens as everyone is rushing to get airborne. A queue forms at the end of the runway and aircraft leave the ground at short intervals. The controller is already answering telephone complaints from the local inhabitants whose week-end "lie-ins" are being rudely interrupted by the roar of engines.

Once airborne you join the other aircraft milling restlessly round the sky. Often a short-sighted enthusiast will decide that you are an attacker and has to be convinced otherwise. When a genuine attacker does appear everyone joyfully opens up to full throttle and heads straight for him. The sweat trickles down your back as you attempt to manoeuvre the aircraft close enough to him to read his registration without colliding with him or with the other aircraft. All the aircraft are travelling at a minimum of 100 m.p.h. Engines frequently begin to misfire after being run continuously at full power, and those unwise enough to take passengers have to deal with their complaints that the constant turns, climbs, and dives are making them feel sick.

Everyone has his or her own theories on the best way of conducting an attack or defence. As an attacker, I think it is

best to do a series of steep turns right and left while working your way to the airfield, as it is difficult to read the wing registration of a constantly turning aircraft. As a defender, it is best to patrol high and dive towards the attacker, unless you are flying a fast aircraft. Often when an attacker approaches, four or five defenders dive after him. They are so intent on catching him that they miss the aircraft quietly sliding in past them. It is best, therefore, not to pursue an aircraft if he is already being chased by several others, but to watch for the one hoping to slip in unnoticed in the general confusion. The aircraft which do land unseen are invariably crammed with passengers, all demanding free breakfasts. Whichever side you are on, you must keep your head turning if you are not to collide with the others.

When the time is up, everyone returns to the circuit and tries to land on the same runway at once. The controller either gives up and shuts his eyes, or the tower flashes green and red lights with bewildering rapidity. The organiser collects the registrations taken by the defending pilots and a tally of successful attackers is made. Stories told over breakfast are full of thrills and suitably embellished with each recitation. If there has been an "incident" the press are there with pencils and notebooks. The final touch is supplied by the controller who comes in for a quick coffee to restore his nerves, calling cheerfully to a friend: "We've got off lightly this time—only twenty-eight complaints from the local residents."

AIR RACING

The heyday of air racing was pre-war in the nineteen-thirties—since then its popularity has declined. But the air racing that does take place in this country is well organised and very enjoyable. To enter for a race it is necessary to have a F.A.I. Competition Licence, obtainable from the

Royal Aero Club. To qualify for this you must have at least 100 hours flying experience as pilot-in-charge, and be recommended to hold the licence by a CFI or an experienced racing pilot.

Most racing is on a handicap basis, so you can enter a perfectly standard aircraft if you wish. If it has been tuned, this will be allowed for by the handicappers. It is better if you own your own aircraft because clubs do not usually like hiring their aircraft for racing. The ideal racing aircraft has a good power/weight ratio, clean lines, good all-round vision, and a high rate of roll. It is the one occasion when the aircraft must be insured.

Handicap races can either be a number of laps round a pylon course, like the annual King's Cup Air Race, or a cross-country race from A to B, or a single lap round a cross-country course. Scratch races are sometimes organised, often for one make of aircraft, so a tuned aircraft here is an advantage.

Unlike motor racing, there is no track to follow in air racing, so unless the course is so small that from one pylon you can see the next, the better you know the route the faster will be your time over it. For pylon racing it is best to study a large-scale map of the area, then fly slowly round the course fairly high to obtain a general view of it. After that, practice must be put in at a low level to get to know the appearance of the ground features when approached on the correct heading. It is sometimes worth making a list of ground features which should be learnt until the sequence is automatic. For accurate course keeping you should aim to see the next checkpoint when over the preceding one, so that there is no chance to stray in between. This type of "instant" navigation has to be used because you are flying low. At a reasonable height you can see landmarks at a distance and adjust your course accordingly, but at a low level, landmarks

are masked until you are almost over them, so you have to navigate on the countryside which lies directly beneath you instead of on what lies ahead. The siting and appearance of pylons should be studied carefully so that they can be picked out at the maximum possible distance.

If the race is over a cross-country course, the greater distance makes it more difficult to know the route in advance. You can, however, learn most of the route by simply studying the map in detail, and then having a trial run to confirm and clarify the picture you have gained from the map. On the day, write out the course headings and put them up somewhere in the cockpit.

Useful Checks

Now you are free to concentrate on the aircraft. Make a scrupulous pre-flight check, paying particular attention to the security of cowlings, bracing wires, and fuel caps. The aircraft must carry the maximum permissible capacity of oil. Regarding petrol, it is best to err on the cautious side when deciding how much to take. It weighs approximately 7 lb. per gallon. All surplus equipment should be removed from the cockpit and spare harnesses fastened so that they are out of the way. Having checked everything outside, seat yourself comfortably and harness yourself in tightly. Start the engine, doing the usual checks, then you are ready to go out to the starting line.

The starter holds up the flag for a few seconds, then it drops and you are off. Do not use flap on take-off as it cannot be retracted until some altitude has been gained, and it gives you a limiting speed until it is raised. There may be a scatterpoint at the end of the take-off run, round which you have to make a turn, before setting off for the first pylon.

All aircraft have maximum permissible rev. settings, but

most pilots take a chance and ignore these. The throttle remains fully open. For maximum obtainable r.p.m., the carburettor heat should be set to "Cold," and a very slightly weak mixture used, but bear in mind that a fully rich mixture gives better engine cooling.

Aircraft Handling

To fly an aircraft straight-and-level at full throttle, you will find that the trimmer will have to be set slightly nose down and considerable rudder will have to be used to keep straight. Aim at keeping both needles of the turn-and-slip indicator absolutely central, because if one wing is slightly lower than the other, or the nose allowed to yaw, the sideways movement will cause loss of speed. Hold the stick firmly and make control movements small and decisive. If you are flying into a headwind, keep close to the ground where the wind is less and you will have a higher groundspeed. If you have a tailwind, let the aircraft gain a little height to take advantage of it. Do not deliberately climb the aircraft; rather let it ease up a hundred feet or so over the distance so that the speed does not drop appreciably. With a beam wind, flying low you will see your angle of drift relative to your heading very clearly.

Pylon turns should be attempted with care. Remember that because the turn is steep the stalling speed will probably be very high. If a stall warning horn is fitted you are warned in time, otherwise be sensitive to the feel of the aircraft and any pre-stall buffet which may occur. Pylon turns must be accurate because they are low—if the aircraft slips inwards it will hit the ground. If you feel the turn beginning to go wrong, put the stick and rudder hard over and stop it, recommencing more gently.

When flying low you have to look ahead of you the whole time, but occasionally glance at the engine instruments to

check that the pressures are staying up and that the temperatures are not rising too high. Should you notice a really abnormal reading, fly back to the airfield and land. You will not win the race by forcing an ailing engine, you will only precipitate total failure and subsequent expensive damage. If total unexpected engine failure does occur, and the engine cannot be coaxed into restarting, use your surplus speed to gain height before switching everything off and making a forced landing.

In all races care must be taken to overtake according to the rules, especially near the pylons. In scratch races it is vital that everyone keeps straight on take-off. When the aircraft go round the pylons in a bunch you have to avoid losing control through hitting another aircraft's slipstream.

Basic craft and skill with an aeroplane and knowledge of the air make a good racing pilot—it is not merely a matter of forcing the aircraft along at full throttle.

A Brief Look at Gliding

THE powered aircraft pilot who flies in a glider for the first time, finds that his immediate reaction is one of surprise at the simplicity and silence of such flight. The roar of the engine is replaced by the hum of the airflow passing over the glider's wings, and the disappearance of the engine also means the disappearance of many gauges and controls which fill the cockpit of a powered aircraft.

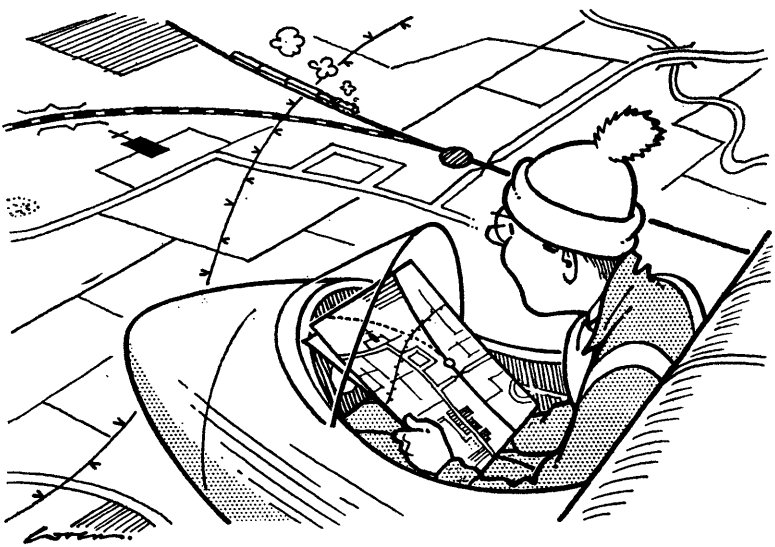
According to aviation law, you do not have to hold a pilot's licence if you are flying a glider for non-commercial purposes. You may fly solo from the age of sixteen, as opposed to the minimum age of seventeen for powered aircraft. The holder of a PPL who wishes to glide is allowed to solo in a glider when his instructor judges him to be competent. If you have no flying experience at all, a minimum of twenty launches have to be completed before soloing. One solo circuit entitles the pilot to his A Certificate, issued by the British Gliding Association on behalf of the Royal Aero Club. The B Certificate is issued after further circuits in which the pilot demonstrates his ability to turn in either direction. In all tests you have to make a good landing. The B Certificate permits the glider pilot to leave the circuit and fly within a five-mile radius of the launching site.

AIRFRAME AND COCKPIT

How does a glider differ in appearance from a powered aircraft, apart from having no engine? The glider is designed to be as aerodynamically efficient as possible. The wings are long and narrow; this high aspect ratio design being the best to obtain maximum lift and minimum drag. On the ground

the glider rests on one wing-tip, as the undercarriage normally consists of one wheel mounted centrally under the fuselage and a skid placed under the nose. The glider is also built to be as light as is practicable.

The controls are the same as those of a powered aircraft—ailerons, rudder, and elevator. There are no flaps to be used for landing, instead there are air brakes and "spoilers,"



Cross-country for powered and non-powered flight presents the same problems

which are used on some types of powered aircraft. These pop up on the top surface of the wing and "spoil" the smooth airflow. Lift is lost and drag increases, which is the required effect on landing and it shortens the landing distance.

The instruments in the cockpit consist, at a minimum, of airspeed indicator, altimeter and variometer. The altimeter is used for actual height reading but there is a

slight time lag before it shows gain or loss of height, and it is not quick enough to indicate to the pilot that the glider has met a rising current of warmed air, known as a thermal, and that he must take advantage by circling, and not flying through it. The variometer is used for this detection of thermals; it has two vertical tubes, each containing one ball. In one tube the ball is red, in the other, green. When the glider is on the ground each ball rests at the bottom of the tube. When the glider is in flight and climbing, the green ball rises in the tube, which has calibrations to show rate of climb. When the glider is descending, the red ball rises and shows rate of descent.

LAUNCHING

Gliders are most commonly launched either by a winch or by being towed to a height behind a powered aircraft. A winch launch, which is considerably cheaper than an aerotow, takes the glider to a height of about 800 feet above the launching site before the cable is released. If the site is a small one, the amount of cable that can be laid out is limited and the launch might terminate at 600 feet. An aerotow takes the glider to several thousand feet. Winch launching is used when a glider is only flying circuits or in the vicinity of the site; aerotowing is used when the pilot aims to fly cross-country. At large sites two winches may be employed simultaneously. Gliders launched by the left-hand winch fly left-hand circuits, and those launched by the other winch fly right-hand circuits. Unlike a circuit at an ordinary airfield, glider circuits may be right- or left-hand, there is no "normal" circuit direction. Launching sites are often at or near the tops of hills and ridges because air flowing against a ridge will cause upcurrents which provide lift for the glider and help to keep it aloft.

ECONOMICS

Gliding is much cheaper than powered flying because of the lesser maintenance costs which are reduced to airframe and instrument maintenance. Club charges are not high, but a club member is expected to give his services in addition to paying for his gliding. As a glider is unable to taxy it has to be towed or pushed into launching position by hand. The member is expected to help with ground handling and preparing to launch the glider for other pilots, as they will help him when his turn comes. There is also retrieving to be done, which is fetching the glider back to base when it has landed in a field. It is normally partially dismantled, loaded on to a trailer, and driven back.

THE CIRCUIT

The beginner will usually start to glide in a Kirby T31 or a Slingsby T21b, as these are the most commonly used trainers. Later he will convert to high performance gliders. A glider circuit is very similar in principle to a forced landing circuit in a powered aircraft, an explanation of which does not fall within the scope of this book.

The glider is put into a launching position with cable attached. The pilot does his cockpit check, which is a simple one. As the glider rests on one wing-tip when on the ground, it is put on an even keel for launching by a man standing at the into-wind wing-tip and holding it slightly down. There is a drill which is run through to check that all is correct and in particular that the cable is not tangled. Finally the "All-out" signal is given to the winch and the glider is dragged forward.

After take-off and cable release, when the glider is normally at about 800 feet, it turns crosswind. It then turns downwind at a minimum height of 500 feet. If the glider is too high, the 360-degree turn is used to lose height.

The rule which is hammered into power pilots when learning to do forced landings, "Never turn your back on the field," is second nature to the glider pilot. This rule means that you must never glide far downwind, leaving yourself any distance to turn and glide into wind to reach your chosen field. You are able to glide flat and far with the wind behind you, but once you head into wind, without an engine's aid you will descend without gaining much forward distance.

The glider, therefore, turns on to base leg at 200 feet or when reaching the downwind boundary of the site, whichever is sooner. If the glider is too high, S turns must be made towards the landing strip. Here again you do not turn your back on the field. The glider turns finals at a minimum of 150 feet. Spoilers are used as necessary. Landing a glider works on the same principle as landing a powered aircraft with the power off. It is levelled out and stalls on to the wheel, then pitches on to the skid. There is a certain amount of deceleration force felt by the pilot and so he must be well strapped in.

The emergency which can occur in a glider circuit is if the cable breaks during the launch. There are laid-down procedures to be followed if this should happen, according to the height of the glider above the ground when the breakage occurs.

CROSS-COUNTRY FLIGHTS

To gain a C Certificate, which permits cross-country flights outside a five-mile radius of the launching site, the glider has to have a winch launch, then stay airborne for a total of fifteen minutes, maintaining height by flying in a thermal or hill soaring for five minutes. A sealed barograph is carried to record evidence of the achievement of the flight. The glider pilot must afterwards pass a written examination on air law.

With a little experience, the most likely location of thermals can be discovered. Providing that a thermal is strong enough a glider circling in it will gain height. There are thermals to be found beneath cumulus cloud. Heat from the sun is the primary cause of the thermals, especially the effect of heating on different surfaces. For example, the roofs of a town will heat up quickly on a summer's day, and the heat will rise in currents. Adjacent fields will heat up more slowly. Therefore you would expect to find your thermal over the town. Land heats more quickly than water, but water will cool more slowly than land when the sun has set.

Cross-country flying is, therefore, dependant on finding the means to stay airborne. The British Gliding Association whose regulations govern the operation of gliders award Silver, Gold, and Diamond badges for distance and duration flights with a height gain. The glider pilot who gains these badges has truly proved his skill in non-powered flight.

OUTDOOR BOOKS

ADÈLE PARK

The young author of this book thinks that flying should be fun. The advice and information that she gives here are from her own aviation experience and intended to help the student and private pilot make the most of his flying. Adèle Park gained her private licence at seventeen and commercial licence at nineteen. She is one of the youngest professional pilots in Great Britain and still retains her interest in club flying.

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