# GLIDING AND MOTORLESS FLIGHT

L. HOWARD-FLANDERS
AND C. F. CARR


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AT THE 1930 DEMONSTRATIONS, ORGANIZED BY THE BRITISH GLIDING ASSOCIATION

Thousands of people saw a glider in flight for the first time. This photograph was taken at Itford Beacon, near Lewes

*Photo "Daily Express"*

# GLIDING AND MOTORLESS FLIGHT

BY

L. HOWARD-FLANDERS

M.I.Æ.E., A.F.R.Æ.S., A.M.I.MECH.E., M.R.S.T.
(MEMBER OF THE COUNCIL OF BRITISH GLIDING ASSOCIATION)

AND

C. F. CARR

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# AUTHORS' PREFACE

THE revival of interest in gliding in Great Britain, which those who had watched its progress in Germany had regarded as inevitable, has called for a book which, without being too highly technical, will give to those who are curious to know something of the new sport an idea of its principles.

As with every other interest that suddenly looms large in the public eye, there are many misconceptions concerning gliding, and one of the purposes of this book is to remove them. The concern of its authors, too, has been to give as simply as possible an explanation of the principles upon which the construction of an efficient glider is based, of the various types of machines in use to-day, and of the way in which a glider is handled in the air.

There can be little doubt, seeing that gliding is, comparatively speaking, still in its infancy, that its development in the immediate future will bring about a good deal of change both in constructional methods and in the air technique of the sport. It is apparent from the progress that has been made in the last few years that only the fringe of gliding possibilities has so far been touched. The concentration of attention upon this special phase of aviation has been an excellent thing in many ways. Of the value to aviation generally of the experiments that have latterly been conducted there can be no doubt; in addition, they have introduced a new and fascinating sport which bids fair to make an almost world-wide appeal. It is obviously a sport which is capable of developing a highly competitive phase, and this in itself is certain to have its

reflection in a continuously stimulative effect upon the development of every kind of sail-planing.

In conclusion, the authors would express their indebtedness to the Royal Aeronautical Society and the British Gliding Association for their courtesy in giving permission for the reproduction of a number of illustrations; to Dr. Georgii, the President of the International Research Commission, and to Herr Fritz Stamer, of the German Gliding School at the Wasserkuppe, for information concerning gliding in Germany, which they have kindly supplied; and to the editors of the *Daily Express* and the *Manchester Guardian* for permission to reproduce copyright photographs.

L. H-F.
C. F. C.

*October*, 1930.

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## CHAPTER I

### AVIATION GOES BACK TO ITS CRADLE DAYS

If birds and flying insects had not been included in the scheme of the Creation, it is fairly certain that the mind of man would never have turned in the direction of flight. There is fascination in the graceful flight of a bird, and primitive man—always peculiarly subject to the fascination of natural phenomena which he did not understand—must have watched with wonder the aerial evolutions of the winged creatures around him.

Some there were, of course, whose aspect terrified him, and whose appearance sent him scuttling for shelter without a moment wasted in either wonder or admiration. These were the flying monsters of those primeval times, of whose fearful aspect we may still gain some idea from the remains which are preserved in museums and the pictures of them which, after infinite labour and laborious research, scientists have been able to reconstruct. But even the clumsy flight of a pterodactyl must have contributed some influence to the gradual growth in the mind of man of the idea of flight.

That the idea did grow and manifest itself early is simply a matter of history. But even so, it is history which is full of the most absorbing interest, for there is no subject which has attracted more widespread attention. For tens of centuries the problem of flight was

a universal problem. The thinkers of peoples, poles apart in their racial characteristics, dreamed of the conquest of the air. They strove to discover its secret just as widely and as hopefully as they sought to find the Philosopher's Stone.

## A Reality

But while the transmutation of baser metals into gold is still the dream of the scientific visionary, the conquest of the air has become a reality. To-day giant air-liners wing their way from capital to capital with the regularity of express trains, even as the pioneers had dreamed. Battles have been fought in the air, even as the imagination of earlier writers had predicted. To-day, with the airways of the world at his disposal, man can literally laugh at the limitations which time and space formerly imposed upon his activities.

Time brings many changes. To-day change operates more rapidly than ever before, for science is always at the heels of Father Time, with reminders that the standards of the youth of mankind are not those of to-day. The coming of the aeroplane was a final gesture —if there can be any finality in scientific discovery— of man's impatience with the state in which Nature had been pleased to leave him.

One of the most interesting phenomena in the incidence of change is the frequency with which man, particularly in the sphere of science, returns to ideas which he had previously discarded as valueless or effete, or not quite up to the pace which the forward march of progress had demanded. There are scores of examples of the way in which man occasionally takes a step back —on the principle of *reculer pour mieux sauter*, as it were—to take another look at a by-way which he had previously thought might lead him nowhere. And

more often than not he has been all the better for the second thought.

## A Step Back

As with other spheres of discovery and invention, so with aviation, which in the past few years—the period which embraces its practical achievement is comparatively brief—has taken an interesting step back, and has applied the lessons to be learned from the experiments of its pioneers in a new way which promises to be fruitful of both discovery and achievement. Aviation, in short, has gone back to its cradle days, and has found in the efforts of its youth lessons which it is now applying to the further development of the science of flight.

This reversion to an earlier stage in the evolution of flying is finding its expression in the new sport of gliding, or sail-planing. One calls it a new sport, knowing that in itself it is now new, because it is only during the last two or three years it has been taken up with any degree of enthusiasm, and because when it was first a subject of experiment the stimulus was not one of sport, but the deadly serious business of seeking a way to the conquest of the air. To-day the air has been conquered, and the method of the conquest is now being bent to the will of man, who does not live by conquest alone, but likes a little relaxation when victory has been achieved.

## Sport with a Thrill in It

The secret of the irresistible appeal which gliding is now making is probably to be found in the fact that it is not only a sport with a thrill in it, but also that it still has a good many secrets of its own, and modern youth wants to find out just what they are. There is no sport more fascinating than that which has an

element of the $x$ quantity in it. There is much in gliding yet to be discovered, and there are plenty of enthusiasts keen to find it out.

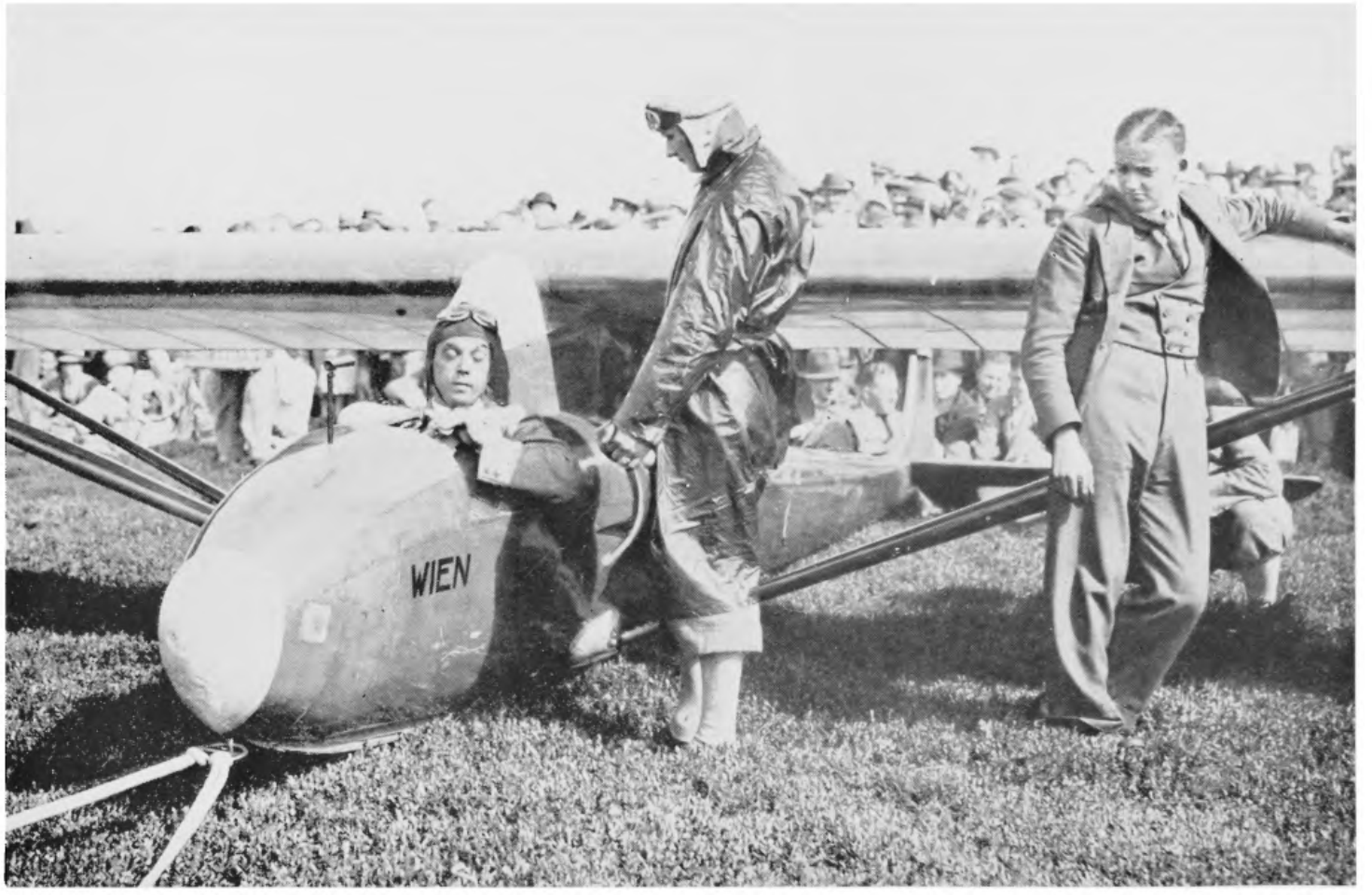
The first question likely to rise in the mind of the reader is: What is a glider? The simplest answer one can give is that it is an engineless aeroplane, which, in the absence of any directly applied motive power, is kept in the air by the skill of its pilot, who takes advantage of favourable air currents to maintain height and even to gain it. Some pilots have acquired great skill in manoeuvring this type of aircraft; it is, indeed, the remarkable feats of many of the experts which have attracted public attention so strongly to the possibilities of the high-performance glider medium of flight.

## Principle Not New

The principle of the glider is not new; it is simply the resuscitation of an old idea. But the first experimenters in this direction were simply interested in it because they had unsuccessfully applied the other methods of flight which had occurred to them, and because the means of applying the motive power at their disposal were distinctly limited. One thing, however, is certain: that the use of a plane surface as a means of supporting and manipulating a heavier-than-air machine was an epoch-making discovery in the evolution of human flight, for it directly paved the way for the coming of the aeroplane, with all the advantages which it has brought to mankind.

The interest which gliding has aroused in Great Britain and which culminated in the 1930 "boom" is reflected in the formation of many gliding clubs. In practically every part of England gliding enthusiasts are represented by strong clubs which are doing much to foster the sport and to spread a knowledge of the

(2058)




HERR KRONFELD, THE FAMOUS GERMAN GLIDING PILOT, IN HIS SAIL-PLANE "WIEN"

This photograph was taken at a gliding demonstration in Yorkshire

*Photo : "Yorkshire Post"*

# PLATE II

ANOTHER PHOTOGRAPH OF A GLIDER IN FLIGHT NEAR LEWES

*Photo : "Daily Express"*

principles of gliding by making it easy to obtain competent tuition.

## Royal Interest

All classes have taken up the sport with zest. Several members of the Royal Family have evinced strong interest in it, particularly the Prince of Wales, the Duke of York, and Prince George. During the visit of Herr Kronfeld in the summer of 1930 the Prince of Wales took the opportunity of witnessing a demonstration by this skilful German pilot. This demonstration was specially arranged for His Royal Highness, who was intensely interested in the evolutions which Herr Kronfeld was able so easily to perform for his entertainment. So delighted was the Prince with what he saw that he dispatched his private aeroplane, whilst Herr Kronfeld was still in the air, to bring Prince George from London in time to allow him to see the glider in flight. Prince George was equally impressed by the possibilities of gliding. Before Herr Kronfeld brought his glider, the "Wein," down to earth, the Prince and he exchanged comments on its flight. This ground-to-air conversation often takes place during gliding demonstrations. It is, of course, an absolute impossibility as far as an ordinary aeroplane is concerned, owing to the noise made by the engine.

## The International Aspect of Gliding

It was apparent, as soon as gliding began to gain popularity, that something must be done to stimulate and to control its international development. No sport in which the people of a large number of nations are able to take part can progress on the right lines, especially in its competitive aspect, unless there is an international body of central control, as well as separate

executives which are responsible for its control in each country which takes an interest in it.

There is every indication that in the course of a few years gliding will become one of the most popular international sports. The widespread nature of the interest which is now being taken in it is shown by the fact that when an International Congress was held at Darmstadt in March, 1930, to consider certain aspects of gliding, representations for the formation of an international body to control it came from Great Britain, France, Italy, Belgium, Germany, Austria, Hungary, and Holland. At this conference it was decided to form an International Research Commission for motorless aeroplanes, and the first meeting took place at Frankfort four months later. At its first meeting four members attended from each of the countries already named.

A good deal of the time of the first meeting of the new Commission was naturally absorbed with preliminary planning, and it was expected that several meetings would have to be held before the Commission would function completely. With gliding in its infancy, as it was at the time, the chief object in view was to guide international enthusiasm into the right channels and to ensure the working of the various national associations on the right lines.

There was only one man who could be made President, and he was unanimously chosen. This was Professor Georgii, the Scientific Director of the Rhön-Rossitten Gesellschaft, which has done so much for the technical development of gliding on the Wasserkuppe. The Master of Sempill, who is President of the Royal Aeronautical Society, was elected as Vice-President. Frankfort is to be the seat of the Commission for the next nine years.

## CHAPTER II

### AN HISTORICAL RETROSPECT

EXPERIMENTS in gliding flight had a prominent place in the early attempts made by air pioneers, to whom due credit must be given for the work they did, always at great risk, in proving the practicabilities of the theories they individually held. Most of the early gliding machines, however, were different in principle and construction from those which are in use to-day. Some of them, particularly those of Lilienthal, a German who met with a fatal accident whilst gliding in 1896, were a combination of the principles of the kite and the plane which is used to-day.

### "The Tailor of Ulm"

History is full of records of early attempts to solve the secret of flight. As far back as 1809 an Englishman, Sir George Cayley, constructed a machine, but it was too heavy to take the air. Some of the early trials ended in tragedy, but others had a decidedly humorous aspect, as, for instance, the exploits of the tailor of Ulm, who, in the early part of the nineteenth century, made himself literally the laughing-stock of Europe by the comic ending of his attempt to cross the Danube at a spot which is still pointed out to travellers down that beautiful river. The "Flying Tailor," as he was called, was, in one way at least, wise in his generation, because he was convinced that it was possible for man to fly. To prove the truth of his theory he made himself a kind of glider, and announced his intention of flying from one high cliff to another. Great crowds assembled to see the exploit, but all that happened was that the

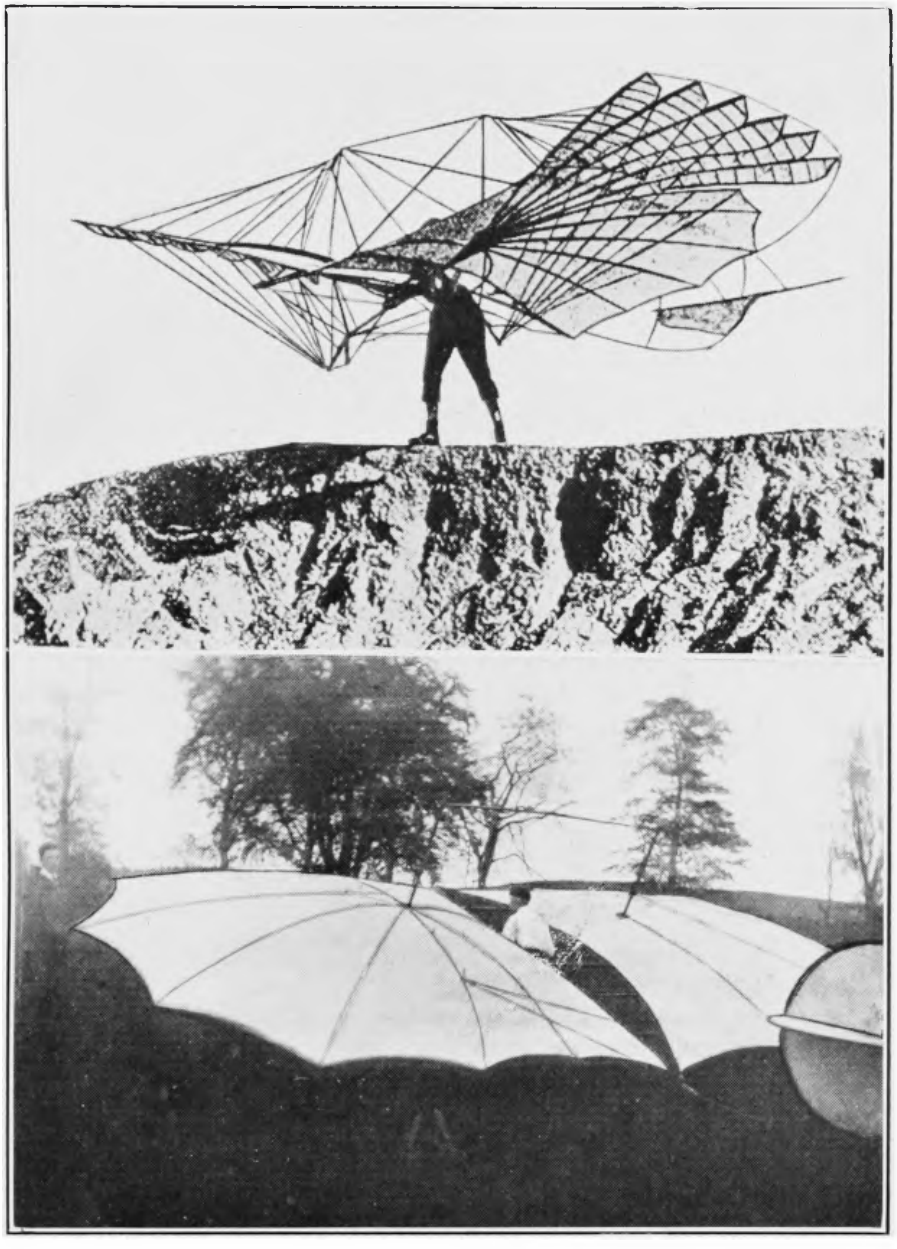
precocious aviator dropped like a brick straight into the water, out of which he was ignominiously hauled by some fishermen with a boathook!

In the middle of the last century a popular sensation of the people was balloon ascents, with many of which were associated acrobatic feats in mid-air. At about this time a number of ascents took place from the old Cremorne Gardens, and at one of these a Belgian gliding aspirant named Vincent de Groof was killed in the presence of a large crowd. De Groof had made a glider with movable wings, with which he sought to imitate the flight of a bird. This contrivance was suspended beneath the car of a balloon and was released with its pilot when the balloon had got to a height of about 2,000 ft. It is recorded that De Groof had already flown his machine with some success on previous occasions, but this time he simply came down like a stone and was killed.

## Lilienthal's Machine

In Lilienthal's machine the pilot sat in the middle of a large wing-like structure, above which was a smaller wing. Lilienthal, who has been described as the "father of the aeroplane," started his experiments by jumping off from an improvised spring board. From this simple beginning, he progressed until he was able to start from the top of a hill and cover a hundred yards or so before coming down to earth again. With his crude contraption, Lilienthal made many hundreds of gliding flights, few of which, however, lasted more than a very few seconds. The only method which the pilot had of exercising any sort of control over his apparatus was by moving his body in order, as far as was possible, to alter the balance and its effect upon the gravity pull of the machine. The wings or planes of Lilienthal's

PLATE III



TOP: LILIENTHAL ABOUT TO ATTEMPT A GLIDE
BOTTOM: PILCHER'S GLIDER, THE "HAWK"



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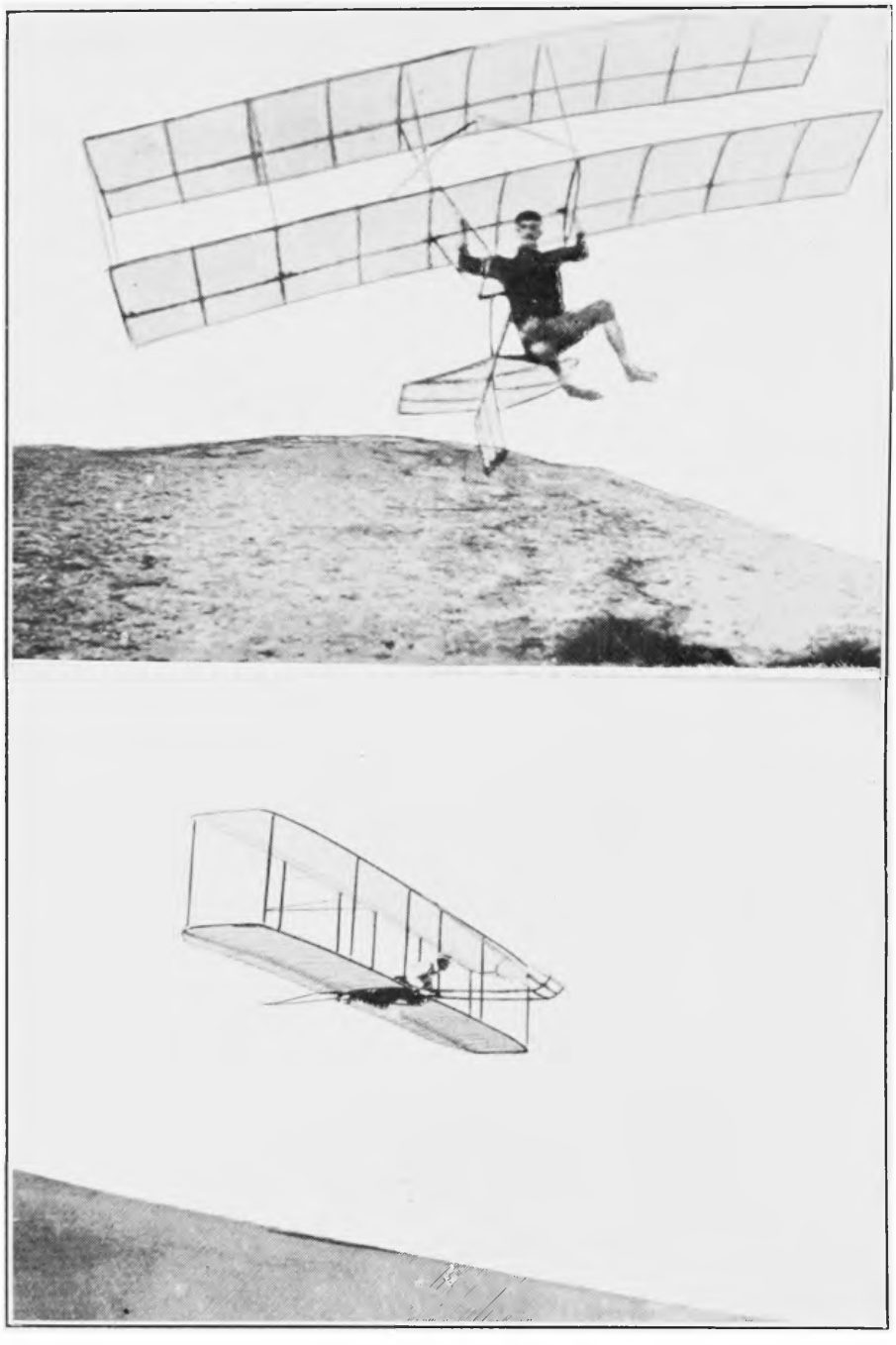
PLATE IV



TOP: THE CHANUTE BIPLANE GLIDER
BOTTOM: THE WRIGHT BROS.' GLIDER

machines presented a slightly concave surface to the air pressure, upon which they depended for their support as soon as the pilot "took off" from high land.

## Pilcher's Ideas

Further developments of the same idea were made in England by Percy Pilcher, who unfortunately met with a fate similar to that of Lilienthal. Pilcher worked on the same lines as his German contemporary in regard to the method of maintaining the balance of the machine.

Pilcher introduced several original ideas in his early gliding experiments. One of them was a new—at that time—method of getting his machine into the air. Lilienthal had restricted his methods in this direction to taking off by the simple expedient of jumping into the air from an elevated position, and he had had places specially prepared for this purpose. Pilcher did some deeper thinking about this important problem, and the result was the employment of a number of horses, which pulled the glider into the air just as if it had been a large kite. When the machine was actually in the air, the towing rope was detached. Pilcher was then free to devote himself to maintaining height and balance.

It is interesting to record that this towing method has since been developed, and applied to modern gliders, motor-cars having been used for the purpose, whilst gliders have also been towed behind ordinary engined aeroplanes. In this respect, Pilcher was undoubtedly a pioneer who did valuable research work, and struck out on at least one new path which has since proved useful.

At about the same time Chanute was carrying out interesting gliding experiments in America. His ideas

were somewhat different, the principal variation in his methods being the employment of movable "planes," with which he anticipated bringing about easier control of his glider.

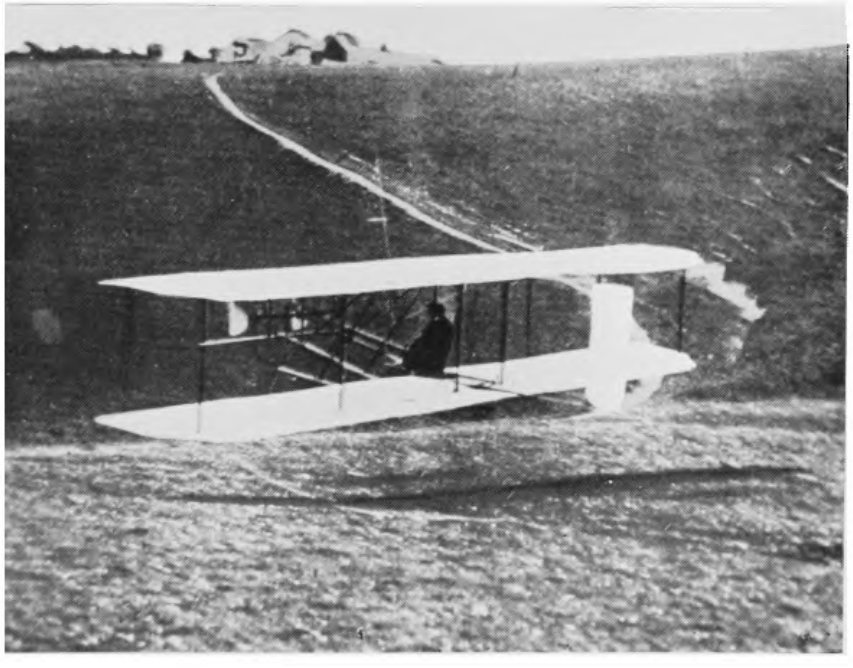
One of his most interesting experiments was the construction of a glider which had no less than five pairs of wings or planes, one above the other. It was also provided with a tail, which gave to the machine some slight resemblance to the constructional form of the early biplanes, except, of course, that the multiple wings were quite unorthodox.

## Chanute's Biplane

To Chanute, too, must be given the credit of constructing the first glider which had any resemblance to those in use to-day. This was a biplane gliding machine in which the inventor carried out a number of flights, which, judged by the standards of achievement of the period, were decidedly successful. Chanute was also more fortunate than Lilienthal, for he survived without injury many hundreds of hazardous flights. It is noteworthy, however, that he did not succeed in breaking Lilienthal's record, which was a flight of 1,200 ft. Chanute's longest flight was 360 ft., whilst Pilcher came nearer to that of Lilienthal with a glide of about 900 ft.

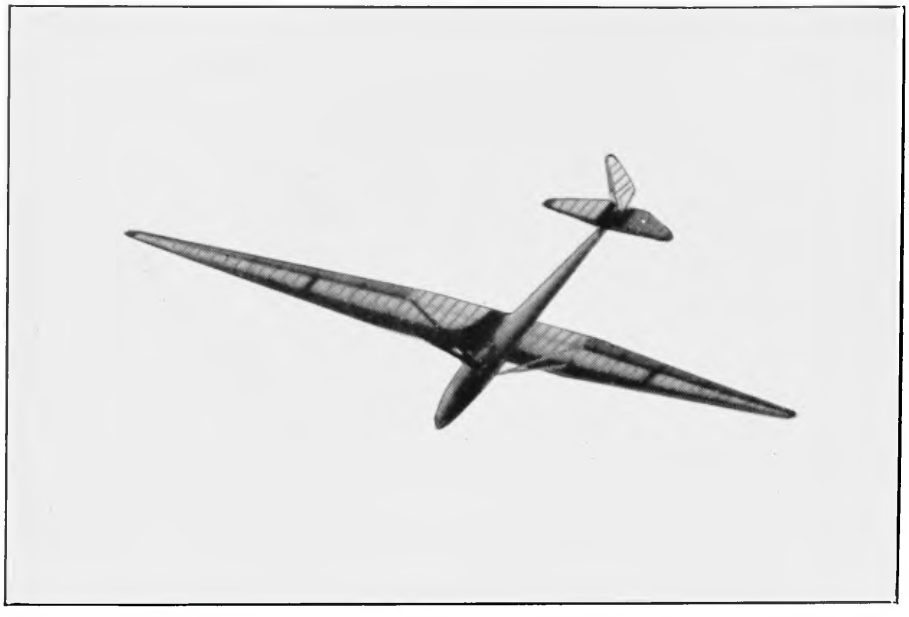
In more than one respect the Chanute biplane glider may be regarded as the first machine of its kind which, in its construction and conformation to orthodox aerodynamic principles, was the real predecessor of the elementary type of glider, such as the Zögling, in use to-day. In flying it the pilot supported himself by his arms on a pair of struts underneath the lower plane of the machine, taking the air by jumping off from high ground and landing on his feet when the machine came

LILIENTHAL, AT THE TOP OF HIS ARTIFICIAL HILL,
ABOUT TO ATTEMPT A GLIDE



THE "POLYTECHNIC" GLIDER ON EPSOM DOWNS
ABOUT 1910

This was an exact model of the Wright Bros.' most advanced glider. Note sitting position of the pilot. The rudder can also be seen



A PHOTOGRAPH, TAKEN WITH A TELEPHOTO LENS, OF A SAIL-PLANE IN FLIGHT


THIS PHOTOGRAPH SHOWS HOW A GLIDER IS CATAPULTED INTO THE AIR

The launching crew are still running, and the tail of the glider has just been released

*Photo: "Daily Express"*

down to earth again, which event, in the most successful flights, was generally only a matter of seconds.

## The Brothers Wright

The brothers Orville and Wilbur Wright, whose names have so honourable an association with the early development of the aeroplane, also carried out a considerable amount of gliding research, which preceded their brilliant pioneer work with their famous biplanes.

The Wright brothers showed remarkable patience in their early attempts to demonstrate the possibilities of flight. They were content at first with a glide which only measured a few yards; at this period of their experiments they seemed to be no sooner in the air than down again. But they persevered, and in 1902, by which time they had gained considerable proficiency in gliding, they were able to give some convincing demonstrations. In one week they accomplished nearly 400 glides, some of them, comparatively speaking, of a considerable distance. Their success attracted no little attention in this country, and at least one English enthusiast, Mr. A. Ogilvie, obtained permission from the Wright brothers to experiment with a similar craft, the Wrights supplying the necessary designs. From the records available it appears that this glider, which was of the biplane type, had a span of 33 ft. In addition to the two main planes, it was provided with an outrigger and supplementary planes, which gave the glider an appearance somewhat akin to that of a modern biplane. The glider was made in two parts to facilitate transportation, which in those days was not so easy as it is to-day, when the roads have been so much improved for motor transport. The method generally adopted for launching a glider in those days was to lay down a special starting rail on the crest of an elevation,

the glider running down the rail until it took the air.

The Wright brothers were responsible for several innovations, which they developed from their first experiments with gliders which resembled to some extent the biplane machine of Chanute. In controlling them, however, the pilot lay flat upon the glider. It was the Wright brothers who also introduced the petrol motor into aviation, and the feats they subsequently performed in the air are well-known and caused a tremendous sensation at the time. There is no doubt that the experience they gained with their gliders was of the greatest help to them when they embarked upon their experiments with a power-driven biplane.

## Private Experiments

Although since the war comparatively little attention had been paid to gliding in England until the 1930 boom, when the demonstration tour of Herr Kronfeld directed attention to the possibilities of the sport, a good many private experimenters have taken a keen interest in it. It is interesting in this connection to note that some of the spots chosen by these pioneers have since been used for the more advanced demonstrations of to-day. Indeed, in one instance in the Isle of Wight, a gentleman who had taken up gliding several years ago, and constructed a useful hangar, was able to place not only his knowledge, but also this accommodation at the disposal of a recently formed gliding club.

In 1904 experiments were being carried out near Winchester by a local resident, who constructed his own glider, and whose gliding attempts caused a good deal of interest in the neighbourhood. In 1908 gliding experiments were being conducted by a number of

young naval officers at Portsdown Hill, near Portsmouth. They persevered for a considerable period with a craft which they built themselves. Two of them, Lieuts. Porte and Pirie, made some quite creditable, if brief, flights in this machine. It is a matter of some historical interest that Herr Kronfeld recently used the same place for demonstration flights. It was near here, too, that he landed after a cross-country flight which started at Itford Beacon, near Lewes, during a demonstration meeting arranged by the British Gliding Association. A party of boy scouts camped in the neighbourhood were amazed when a glider appeared out of the blue right over their small camp, and, still in the air, the pilot nonchalantly asked for his bearings!

Amongst the spectators who witnessed Herr Kronfeld's flight from Portsdown Hill were some who had seen the earlier attempts of the young naval officers, and they were frankly amazed at the contrast presented by the seemingly effortless soaring of the famous German pilot, who hovered above them like a bird, and the short, jerky "hops," usually ending in a small crash, of the 1908 pioneers. It was, indeed, a wonderful lesson in the glider progress of two decades.

## The 1922 Meeting

One of the most notable gliding events of recent years in England was the gliding meeting held at Newhaven in 1922. This provided the most successful flights that had so far taken place in this country, and, in particular, the feat of Maneyrol, who remained in the air for three hours and twenty minutes, caused a mild sensation. It was performances of this description which gave the stimulus to the light aeroplane movement in Great Britain, and to them we are thus indebted for a good deal of the progress that has been

made in engined craft since the end of the war. In this connection, too, the fact must not be overlooked that the war itself gave a tremendous stimulation to aviation, and that the technical data acquired during the war years by pilots, who had to take all sorts of risks on the spur of the moment, resulted in more progress being made in aircraft design than would probably have resulted from a decade of ordinary peace-time research.

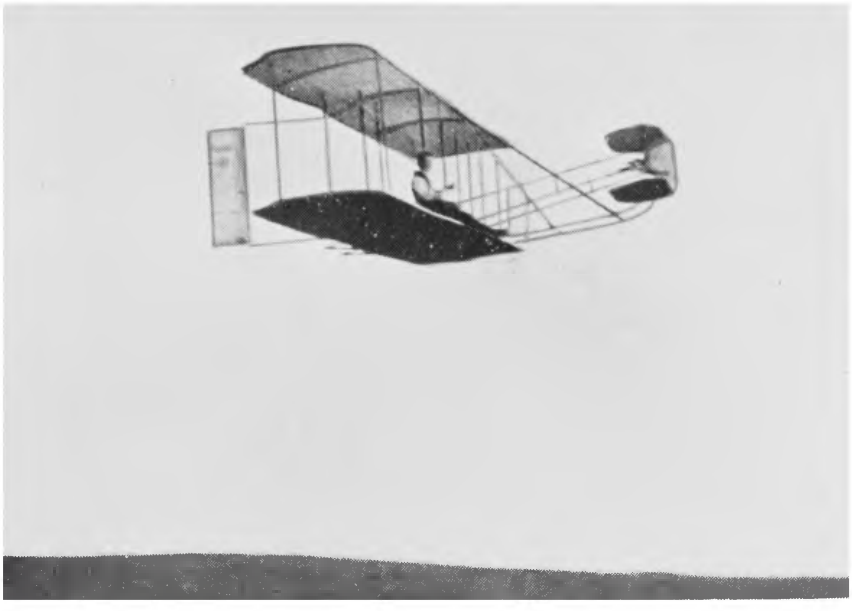
Since the 1922 meeting gliding has been done privately from time to time in various parts of the country, but it was not until the meetings at Itford Beacon in 1930, and the demonstrations which followed all over the country, that the sport really came into its own in England.

## Herr Kronfeld's Display

At these later meetings, in arranging which the British Gliding Association took a prominent part, people who had never seen gliding before were astonished at the evolutions of Herr Kronfeld, the German gliding "ace," who was the star performer at each of these meetings. For the first time, too, some of the recently-formed gliding clubs were able to give the public an idea of the possibilities of the sport in amateur hands. The meetings also gave opportunities to some experienced aeroplane pilots to try their hands at gliding, and a very good job they made of it.

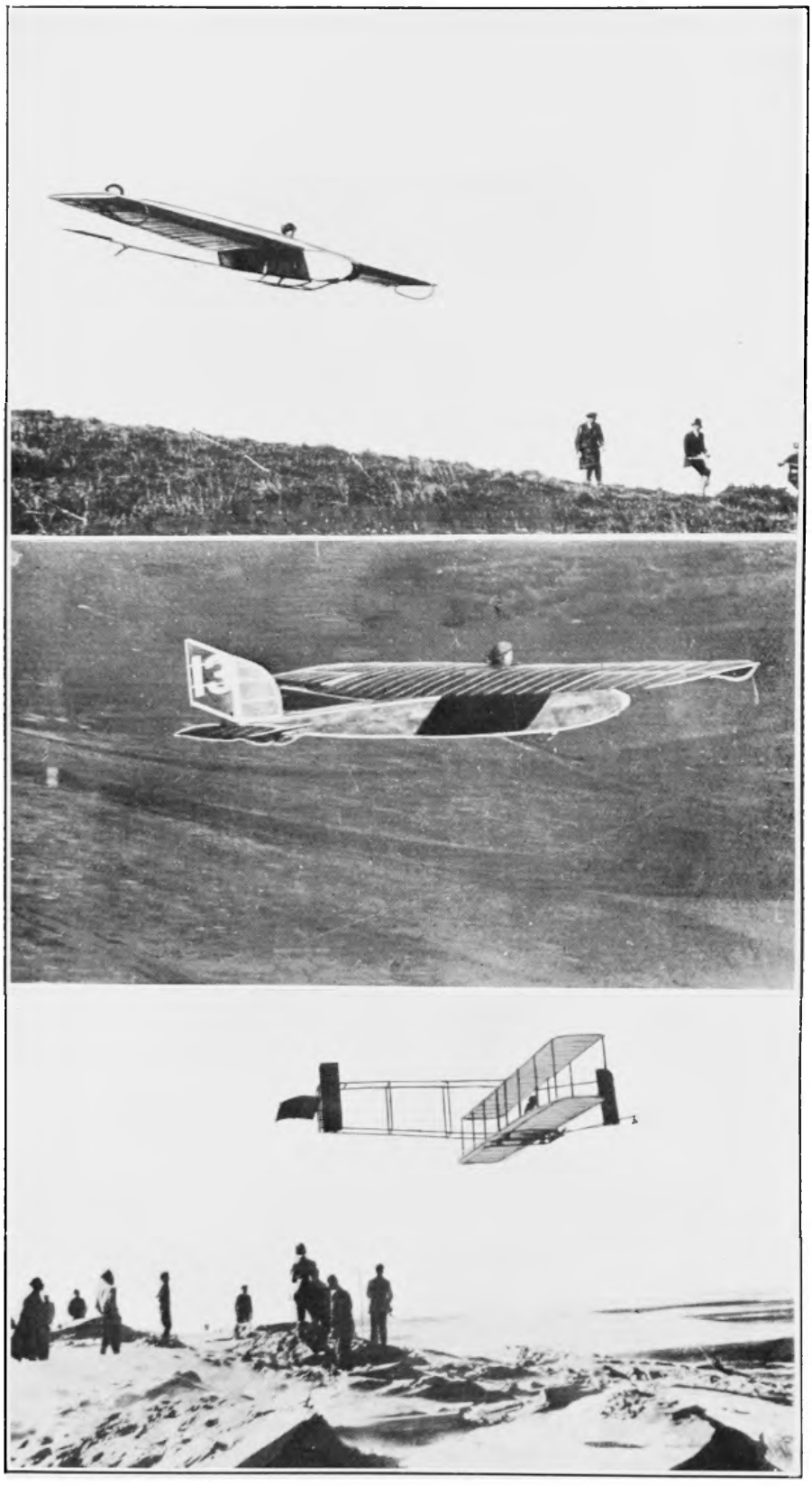
Captain Needham, who had only recently taken an interest in gliding, gave some very good performances at the Itford Beacon meeting, where also the Master of Sempill, who is President of the Royal Aeronautical Society (which has done much valuable work in aeronautical research during a period of 64 years), went up in a glider and stayed in the air for 17 minutes. The Master of Sempill was delighted with the experience,

# PLATE VII



THE "POLYTECHNIC" GLIDER IN THE AIR

THE "WEISS" GLIDER OF THE "AUTOMATICALLY STABLE" TYPE



TOP AND CENTRE: RAYNHAM GLIDING AT ITFORD IN 1922
BOTTOM: A WRIGHT BROS.' GLIDER SOARING AT KILL DEVIL HILL IN 1911, WHEN THEY BEAT THE THEN WORLD'S RECORD WITH A SOARING-FLIGHT OF ONE MINUTE

and predicted that the fine sport of sail-planing was at last to gain a real hold in England.

## The Safety Element

In this connection, whilst it is evident that in modern gliding there is a certain element of risk, it can be said that it is practically negligible, providing the pilot is properly trained. In the last ten years, during which gliding has been carried out continuously in Germany, there has only been one fatal accident. Gliding, indeed, is far safer than a good many other sports, and enthusiasts who take part in motor-car races and similar sporting events undoubtedly take far greater risks than any gliding pilot, even when he is flying in comparatively unfavourable weather conditions.

In Germany, indeed, gliding has become the sport of the younger generation, and it has now reached the stage when standard type gliders are being manufactured in large numbers and offered for sale to the general public just as motor-cars are available to all and sundry. Indeed, one special type is made specially for schoolboys. A glider bought in this way costs on an average about £20 in that country.

## Boy Pilots

It is now a common sight in the Wasserkuppe district to see little groups of gliding enthusiasts scattered all over the countryside at points especially favourable to gliding, some taking off with the help of their comrades, and others gliding gently down to earth after a flight of a more or less lengthy period over hill and dale in that attractive country. The students in the higher schools are especially enthusiastic, and that gliding is remarkably safe is proved firstly by the readiness with which they are allowed to carry out their experiments

(under, of course, competent instruction), and, secondly, by the remarkable success with which they master the principles of the sport. Some of the older schoolboy glider pilots in Germany have remained in the air for periods up to an hour, and covered quite respectable distances in that time.

## The Plane

A little consideration would seem to prove that it was inevitable that the first experimenters in solving the problem of flight should direct their attention to the special qualities of plane surfaces, such as those which are now used in every type of heavier-than-air machines. The plane is merely a development of the lifting power of the kite. It maintains its position in the air by virtue of the air pressure on its under surface.

The maintenance of that pressure is due to a combination of the force of gravity and the artificial power supplied by the engine. The discovery of this principle is older than many people think. As early as 1810 Sir George Cayley designed a machine in which this principle was incorporated, but the ideas upon which it was based did not receive the attention which they deserved from other enthusiasts who were his contemporaries.

## Santos-Dumont's Experiments

The name of Santos-Dumont is generally associated solely with dirigible flight. It is, however, a matter of aviation history that the young Brazilian, who first gained fame for his dirigible flight round the Eiffel Tower, and who won the first big money prize for such a feat, at one time took a keen interest in gliding. With the pioneer work of Lilienthal and his contemporaries to guide him, he constructed a glider, but

# PLATE IX

THIS PHOTOGRAPH SHOWS A GLIDER ON THE POINT OF DESCENDING AFTER A CROSS-COUNTRY FLIGHT

*Photo : "Daily Express"*

## PLATE X

HERR MAGERSUPPE, A WELL-KNOWN GLIDING EXPERT, CONSULTING THE WIND GAUGE OF HIS SAIL-PLANE BEFORE COMMENCING A FLIGHT IN YORKSHIRE

*Photo : "Yorkshire Post"*

decided to break away from previous convention and to operate it from the sea instead of from land, as those who had preceded him in this sphere of experiment had done. Santos-Dumont's glider was one of his own construction, and it was subject to the same difficulties as had been experienced by other experimenters. The greatest of all was the problem of keeping the glider on an even keel, for its balance was liable to be upset by a sudden gust of wind.

However, Santos-Dumont achieved sufficient success to show that he was working on the right lines. His success, at all events, was sufficient to turn his thoughts in the direction of equipping a glider with some sort of engine. With this object in view, he constructed another glider of a biplane design, fitted with an eight-cylinder engine and a double-bladed propeller. A new idea was the use of an attachment like a huge box-kite, which took the place of an elevating plane. In this awkward-looking contrivance, which cannot fail to cause amusement when one compares it with the graceful aeroplanes which are so common to-day, Santos-Dumont gave sufficient proof of his prowess to arouse considerable enthusiasm.

Bleriot (on the Seine) and Archdeacon (on the Lake of Geneva) also made interesting experiments with hydro-aeroplane gliders, the results of which helped to pave the way to practical achievement.

# CHAPTER III

## RECENT ACHIEVEMENTS AND PROGRESS

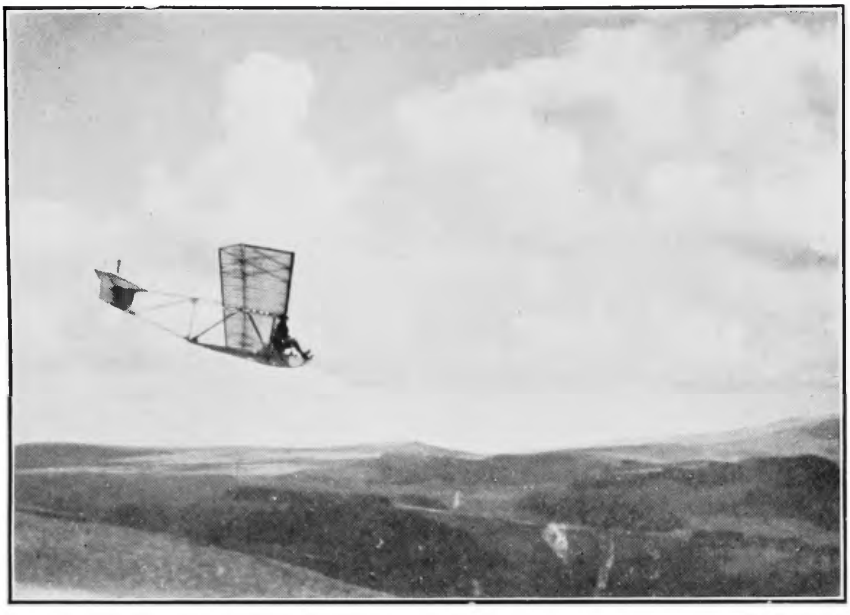
DURING the past decade Germany has been in the forefront of experimental gliding, and the pioneers who have been regularly taking part in the competitions in that country have not only set up some remarkable records, but have also accumulated a mass of data which has proved an invaluable addition to the scientific technique of the subject. The progress made in gliding in Germany has been attributed largely to the restrictions imposed upon engined aircraft in that country since the war. Whilst this may have been partly responsible for the German achievements, there is little doubt that the German pioneers have taken a keen interest in gliding for its own sake, and in setting down the recent history of the sport full credit must be given to them for what they have done.

It is almost entirely due to the public concentration of opinion upon recent record gliding "flights" in Germany that there has been the great revival of interest in soaring flight in this country and in other parts of Europe and in America. Whilst the Germans were by no means the first to plumb the possibilities of motorless flying, it is to them that we owe the expansion of interest in it which has now become almost world-wide.

### Revival in Germany

The German revival of interest in gliding dates from 1920, when a post-war blaze of aviation enthusiasm passed over the country. The direction of the attention of young Germany to gliding as a means not only of

PLATE XI



INSTRUCTIONAL GLIDER "ZÖGLING" OF THE RHÖN-ROSSITTEN, 1926

SAILING AIRCRAFT "CONSUL" OF THE DARMSTADT ACADEMIC FLYING GROUP, 1923

# PLATE XII

KLEMPERER'S SAILING AIRCRAFT, 1920

SAILING-FLIGHT GROUNDS AND FLYING STATION ON THE WASSERKUPPE IN THE RHÖN

flight, but also as a new field of aeronautical investigagation was due primarily to Oscar Ursinus. He was responsible for the first of the famous gliding competitions at the Wasserkuppe, in August, 1920, which has been followed by similar meetings of gliding enthusiasts which have made history. There can be no doubt that the intention of Ursinus was to develop the light aeroplane through experiments in gliding, direct experimental work with aeroplanes themselves being prohibited by the restrictions which had been imposed after the war.

Ursinus could see that there was a strong sporting inducement for young would-be pilots to turn their attention to motorless flight, which would give them nearly all the thrills of flying without the attendant expense. There were difficulties in the way, of course, but Ursinus tackled them with enthusiasm and determination, and after the first Wasserkuppe competition gliding had definitely taken its place as a worth-while sport and a valuable field for experiment.

## Klemperer's Monoplane

It was at this first competition that W. Klemperer, who had designed a glider of the cantilever low-wing monoplane type, set up a new record of 2 minutes 22 seconds, and 1,830 metres. This was quite a good performance in those days, and Klemperer's glider became a popular design.

A glider which incorporated several new principles, some of which are still to be found in the glider planes used to-day, was the "Vampyr," which was designed by G. Madelung. He may be said to have exerted considerable influence on glider design. The "Vampyrs" were so designed that they had a much lower rate of descent, and were thus able to take better

advantage of uprising currents of air. With them far better performances were possible, and it was not long before this fact was amply demonstrated. In 1922, for instance, two students, Hentzen and Martens, succeeded in remaining aloft for over an hour in "Vampyr" gliders. When Hentzen got up to an altitude of 350 metres, and stayed in the air for no less than 3 hours 10 minutes, people began to believe that there was something in gliding after all, and to visualize the time when man would actually be able to fly like a bird.

## Wasserkuppe Experiments

At this time the Wasserkuppe experimenters were beginning to discover that there was a good deal more in gliding than at first had been realized, and that a successful gliding flight was dependent upon a number of conditions other than the first essential of an efficiently-constructed gliding plane. They were learning to make greater use of varying air currents, and literally to use the energy imparted by the motion of the air. They were learning, too, to judge the type of current to be expected from a certain natural configuration of the land beneath them, and were becoming more and more expert in gliding from one ascending current to another and in gaining height from favourable air conditions.

They were finding, in brief, that successful gliding is largely a matter of the use of intelligence plus careful observation. From these lessons they were learning much, and were gradually building up the scientific basis of the sport.

## New Records

The records of the German pioneers were quickly excelled. In 1924, for instance, Schultz, gliding at

Rossitten, made a record of 8 hours 24 minutes, and in 1925 the same pilot set up a record of 14 hours 7 minutes. At the Wasserkuppe in 1928 Herr Kronfeld, who has since done so much in this direction, remained in the air for 7 hours 24 minutes, and in 1929 Neininger was soaring over the Wasserkuppe for 8 hours 24 minutes. In the same year, at Rossitten, Dinort set up the fine record of 14 hours 43 minutes.

The difference in the methods of modern gliding experts, which, of course, has resulted from the lessons learned from the work of the pioneers, has been well explained by Professor Dr. Walter Georgii, of Darmstadt, who, in an address to the Royal Aeronautical Society, showed how the first soaring flights of Hentzen and Martens, on the "Vampyr" type of glider, revealed the possibilities of soaring flight, as opposed to mere gliding, by using the energy of the air's motion.

## "Static Soaring"

"In accordance with the laws of motion," he said, "soaring is possible in an ascending current of air and in an horizontal air current of variable velocity. When the rate of ascent of the air current equals or exceeds the rate of descent of the glider, 'static soaring' is possible. When the horizontal wind is variable the pilot gains height as the velocity decreases. As the air forces are proportional to the square of the air speed, it is possible in principle to obtain a net gain. If the net rate of gain equals or exceeds the rate of descent, this 'dynamic flight' becomes possible. It is quite probable that some dynamic gain was obtained in the earlier flights, but not by any systematic use of the wind fluctuations. The extensive efforts made from 1921 to 1923 to connect pulsating dynamical effects with the performance of man-carrying gliders did more

harm than good to the development and reputation of soaring, the possibilities of which, apart from any such effects, have been fully shown by the subsequent years."

Dr. Georgii, in making a comparison between the records at the Wasserkuppe and those at Rossitten, pointed out that cross-country flights have been preferred at the Wasserkuppe as eminently serviceable for research work, and, by this means alone, new regions of favourable rising winds have been delimited, and the practice of soaring has been made less dependent on time and place. The performance has been steadily improved, and a high aeronautical and scientific standard of instruction in the methods of soaring has been attained.

## Recent Records

The progress of soaring flight in Germany is very well illustrated by the outstanding cross-country flights since 1922. In that year Martens covered a distance of 9·5 km., and in 1923 Botsch extended the record to 19 km. Since that time the following records have been made—

| *Year.* | *Pilot.* | *Distance in Km.* |
|---|---|---|
| 1925 | Nehring | 21 |
| 1927 | Nehring | 52 |
| 1928 | Schulz | 62 |
| 1929 | Nehring | 72·3 |
| 1929 | Kronfeld | 100 |

In each of these cases the pilots carried a barograph, so that the heights attained were accurately recorded, and careful records of the flight data have been preserved from the instrument readings, amplified by the information supplied by the pilots. Diagrams of these flights give a very fair idea of the skill with which the German pilots took full advantage of the air currents

# PLATE XIII

TOWED-FLIGHT ON THE WASSERKUPPE

WESTERN DECLIVITY OF THE WASSERKUPPE, RHÖN
MAIN SAILING-FLIGHT DECLIVITY

PLATE XIV

"VAMPYR" GLIDING, 1921

GLIDING GROUND AT ROSSITTEN FROM THE NEHRUNG

set up by the contour of the land over which they were passing. The Germans have undoubtedly made great progress in applying topographical and meteorological data to the problem of cross-country soaring. They have proved themselves expert in this fascinating cross-country work, and there is little doubt that the gliding research which is still being carried on enthusiastically at the Wasserkuppe will result in the discovery of many more valuable secrets of soaring flight.

## Progress Made

The progress so far made may be summed up in this way: A pilot can be catapulted into the air at a suitable spot and glide to a distant point, providing there are areas of rising wind to enable him to maintain height. It is quite possible for a pilot to land at a point higher than that from which he took off. In some cross-country flights, pilots, finding that they have lost height, have returned to a spot where there is a favourable rising current and have manoeuvred there until they have risen sufficiently high to soar to another point where a rising current is available.

It will thus be seen that the pilot of a soaring glider is very much like a master mariner in a sailing craft; he is entirely dependent upon air currents to transport him from place to place. He has to lay a course, which he is able to judge largely by the lie of the land, in order to take advantage of the prevailing winds. He is entirely at the mercy of the air currents, and his own particular "doldrums" are land areas where favourable currents are entirely absent.

## Limitations Overcome

But the limitations imposed by currental variations are being gradually overcome, and glider pilots of

to-day are able to cover distances which ten years ago would have been considered impossible without the power of an engine. The problem upon which attention is being immediately concentrated is that of gliding over flat areas where the rising currents are negligible. Once this problem has been solved—and there is little doubt that it will largely be solved—gliding will have become much more than a sport. It will then be, subject to its own limitations, the most fascinating, and certainly the cheapest, medium of progression from place to place that man has discovered.

One direction in which interesting developments have taken place within the last two or three years has been in that of cloud soaring or cloud flying, in which the glider pilot takes advantage of the uprising currents under cumulus clouds. In this the Germans have again been in the forefront of experiment, and the results they have obtained give promise of even more remarkable achievements in the immediate future. That cumulus clouds give rise to vertical currents was discovered by the early flyers, and the adaptability of these conditions to successful soaring over flat land surfaces has now been established by the German gliders, who, in a short time, have become highly skilful in using the knowledge they have gained by practical experiment in the air.

## Two Methods

Gliding can thus be divided into two methods—hill soaring, in which the presence of high land provides the necessary supporting air current; and, secondly, cloud soaring, where the presence of a cumulus cloud provides the same influence. Up to the time that cloud soaring had been tried and found possible gliding could only take place in the neighbourhood of hills, and a

cross-country flight of any length had so to be planned beforehand as to enable the pilot to keep himself aloft by following the course of "friendly" hills. Now, by taking advantage of the two methods, a pilot can soar over flat land by flying from cloud to cloud. Herr Kronfeld, for instance, adopted this method when he made his interesting flight at the Himmeldankberg in August, 1928.

As described by Dr. Georgii, Kronfeld started from the western slope of the Wasserkuppe and flew towards an approaching cumulus cloud, continually gaining height until he was 470 metres above the starting point. Finding that the cloud was dissipating, the pilot, losing height, flew to the Himmeldankberg, manoeuvring over it until he had again reached a good height. He then took advantage of the approach of another cumulus cloud to gain further height, and, flying from cloud to cloud, he reached the Wasserkuppe at the maximum height of 540 metres above his starting point.

## The Possibilities

This combination of the two methods opens up considerable possibilities. A pilot arranging a long cross-country flight could pre-arrange it according to the contour of the land, but he might be able to effect helpful short-cuts by using the cumulus cloud that he met with to cross flat land from one point to another. There is little doubt that the record cross-country soaring flights of the near future will be made on these lines.

Flights by other pilots have shown equally interesting results in actually flying into cloud. Carrying a passenger in a two-seater glider, Groenhoff soared through a cumulus cloud to a height of no less than 1,250 metres above the starting-point, covering a distance of

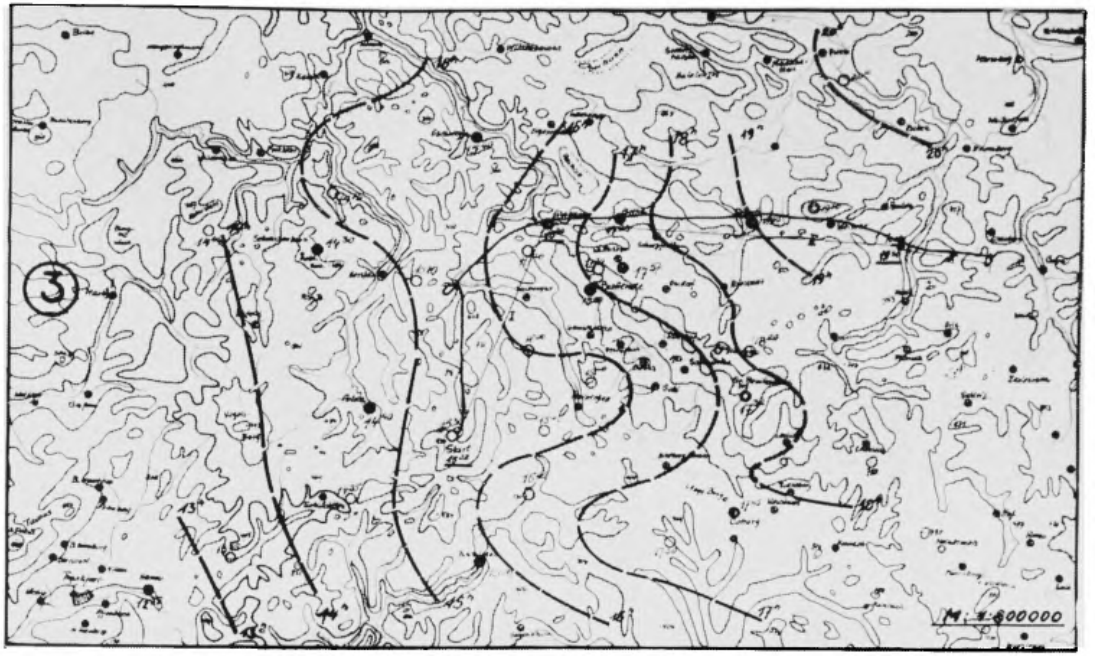
33·3 kilometres. The Germans have further probed the possibilities of gliding in the upper air currents by towing gliders by ordinary aeroplanes to considerable heights, and then releasing them to continue cloud soaring experiments.

## German Research

German glider research has also revealed another valuable fact—that gliding can be carried out even in the face of a storm. Several remarkable flights have been made under these weather conditions. Herr Kronfeld has been particularly successful in this kind of gliding. Everything that has been so far achieved in gliding, indeed, goes to prove that the glider pilot of the future will be deeply weather-wise and highly skilful in using not only the air currents which exist under normal conditions, but in flying literally in the face of the storm, and robbing it of all its terrors, which he will turn to his own flying advantage. His faculty of extracting from the lie of the land every degree of help which favourable currents will give him will be almost a sixth sense.

He may perhaps be assisted also by scientific discoveries and consequent inventions of which we have no present conception. Perhaps some instrument, which in the future will be completely commonplace, will provide him with a means of *seeing* the flow of air currents some distance ahead of him, and thus enable him to surmount his difficulties by intelligently anticipating them. We are using inventions to-day quite as wonderful in their way as this, and we can have no doubt that scientists of the future will be even more fertile in discovery than those of to-day.

# PLATE XV

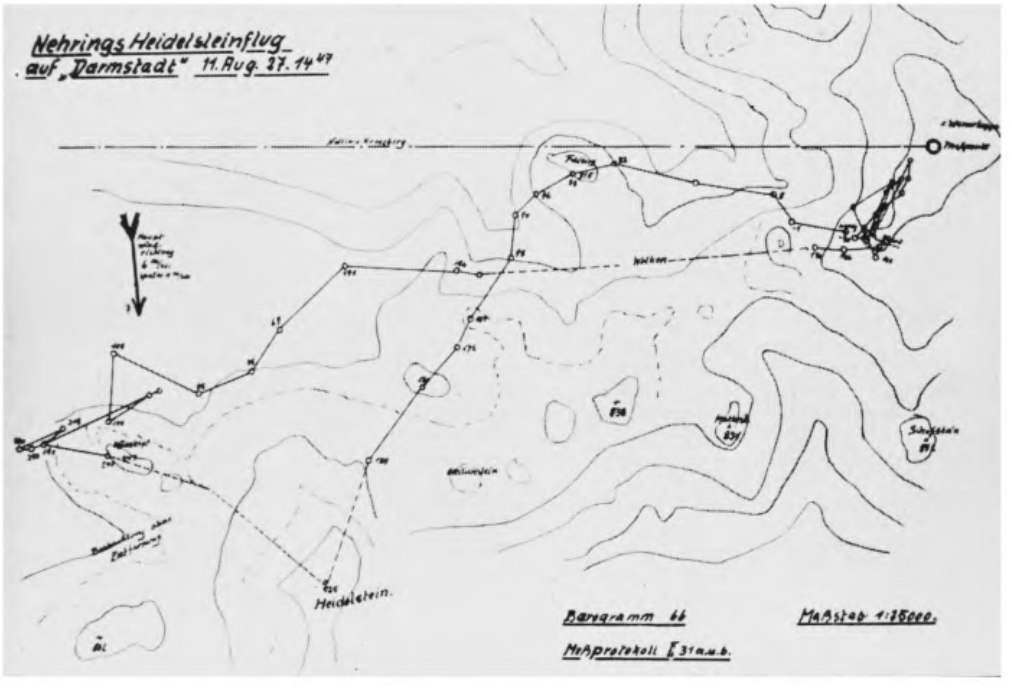



ROUTE SAILING-FLIGHT BY KRONFELD OF 143 KILOMETRES IN THE FACE OF A STORM

(3) Movement of the face of the storm and horizontal path of flight

# PLATE XVI


FRENCH SAILING-FLIGHT GROUNDS NEAR VAUVILLE




HEIDELSTEIN FLIGHT BY NEHRING ON THE SAILING AIRCRAFT "DARMSTADT," AUGUST, 1927

Course of flight according to trigonometrical measurement

# CHAPTER IV

## HOW A PILOT IS TRAINED

In view of the rapid formation of gliding clubs in this country, the training of pilots is a matter of considerable importance, and, now that gliding is becoming the sport of the many instead of the interest of the few, attention has been directed to evolving a definite scheme of training which will produce the best results.

In Great Britain the control of gliding in all its aspects is vested officially in the British Gliding Association, which has already done a great deal to place gliding on a regular, safe, and scientific basis. It is obvious that the future of gliding promises developments which will make its control during the next few years a matter of no little importance, and it is well that the early stages of its growth in this country should have been stimulated with care and discretion.

The fascination of the new sport has made a popular appeal, but it is easily apparent that there are aspects of it which require common-sense administration by a central body. When gliding first began to boom in England a good many people seemed to think that a means of flying had been discovered absolutely devoid of danger, and requiring practically no skill or air experience. It was, indeed, no uncommon experience for the British Gliding Association to receive letters from small schoolboys asking for plans for the construction of a glider suitable for a boy of 14!

The fact is, of course, that, providing a pilot is carefully trained, there is a minimum of danger in gliding, but that it is quite possible for an inexperienced and badly-trained enthusiast to do both himself and other

people quite a lot of harm. If it is not properly controlled, it is possible for a glider to have almost as bad a crash as that to which an ordinary aeroplane is liable when it gets out of control.

## Control Necessary

It would obviously be the height of foolishness to allow all and sundry to build gliders which might or might not hang together in the air, and to go up in them without any official safeguards or technical supervision. The British Gliding Association, in short, is the Air Ministry of gliding, and the regulations which it has to enforce are simply designed to regularize the sport on sound, common-sense lines.

The training system so far evolved in this country includes three degrees of pilotage. The "A" certificate is granted when the beginner has passed his test on the Class 1 glider. The test for this is a flight for 30 seconds in a straight line. This sounds very simple, but it is really not so easy as it would seem, particularly on the type of glider at present used for this test, which is built for safety rather than for performance. The "B" certificate calls for two flights of 45 seconds each and a third of 60 seconds, in which an "S" turn has to be made. Both these flights are made on gliders which are the training machines for sail-planing.

## Later Tests

An intermediate training machine is necessary for the next step. This type of glider is more efficient than the primary training type, but is less costly and stronger than the sail-plane. At this point, the pilot has to put in a considerable amount of practice before he is ready to attempt the qualifying stage, which consists of a 5 minutes' flight at an altitude higher than the starting

point, and returning to the starting point to land. This feat will gain him the "C" certificate. He is then ready to tackle the higher performance work on specially-constructed sail-planes, such as those on which Herr Kronfeld has given such interesting demonstrations in this country.

The technical details of the different types of gliders used, both in this country and abroad, are dealt with in another chapter. It is sufficient here to say that, providing the pupil has confidence and obeys carefully the directions of the instructor, the dangers in gliding are relatively small. The greatest danger is probably that the pupil may want to attain proficiency before he has mastered the elementary details of the sport.

## Training Not Long

The gliding beginner must find his "wings," so to speak, in a series of easy stages. It is not a long business to learn to glide, and it requires no special aptitude, except ordinary intelligence and quickness to grasp the why and wherefore of what one has to do. Some pupils learn much more readily than others, but none take very long over the job, particularly when they are young and enthusiastic. Gliding, of course, is a sport which appeals most strongly to young people, and it should have a big effect in the immediate future in developing air-mindedness in the youth of the nation.

The system of gliding tuition which is most generally followed in this country is that which has been evolved from the experience of the sport in Germany, where considerable attention has been devoted to systematic tuition in the training schools there which have come into existence. One of the most interesting of these schools is the Flying School at the Wasserkuppe, which

may well be regarded as the home and the nursery of modern gliding. This school has been established on modern lines, and the whole of the training is carried out with scientific exactness.

## A German School

The Wasserkuppe was chosen for its special adaptability to the needs of gliding, and the school itself is situated right in the centre of a splendid gliding country. The school is equipped with a large hangar, and has facilities for boarding a considerable number of pupils, the average taking the course being from 40 to 45. The growth in the number of pupils has necessitated the provision of an annexe. In addition, there are workshops and offices, together with accommodation for the instructors and the mechanics, and quarters for the Director of Research and the Director of the School.

The mechanical equipment of the school is adequate to meet all the needs in the construction of planes and for repair work. An interesting novelty was the provision of a wind-tunnel room, where pupils are able to experiment and to receive preliminary instruction in actual air conditions. (It is interesting to note, by the way, that something on similar lines has recently been provided in this country to enable would-be aeroplane pilots to discover what it is like in the air without actually leaving the ground.) So self-contained is the school, indeed, that it has its own sick-bay and laundry.

The school has also its own electric lighting and power plant, and water is pumped electrically to the building. The pupils take their meals together in a dining hall, and receive their instruction in a lecture hall. This part of the building is named Ursinus House, as a compliment to the man who gave the greatest

PLATE XVII

AN INTERMEDIATE TYPE GLIDER IN FLIGHT

A "CLOSE-UP" PHOTOGRAPH OF A GLIDER PILOT SITTING IN THE COCKPIT OF HIS MACHINE

Note the catapult launching ropes attached to the ring in the nose of the fuselage

*Photo : "Manchester Guardian"*

stimulus to modern gliding in Germany. The instructional and technical side of the work is controlled by a number of expert instructors, whilst the research department has its own heads of sections, who specialize in definite aspects of glider research.

## Five Types Used

According to details supplied by Herr Fritz Starmer, from 200 to 250 pupils pass through the complete course in a normal session of seven months. Five types of gliders are used, i.e. the "Zögling," for beginners; the "Prufling," for soaring practice; the "Hangwind," for soaring in light winds; the "Canossa," a two-seater soaring type; and the "Professor" type for high-performance soaring flights. Last year, out of 269 pupils 139 passed the "A" test, 121 the "B" test, and 30 the "C" test. The ordinary course taken by pupils is of four months' duration, and ends with the "B" test. For pupils who show the necessary skill, and who are desirous of taking the advanced course, a further four weeks' training is provided, which takes them through the "C" test, including the handling of all types of gliders.

The school concentrates on solo piloting. "The instructor," says Herr Starmer, in describing the ordinary training work, "explains the conditions of steady flight and the effects of the controls, warns the pupil against common mistakes, such as stalling and abrupt movements of the controls, and advises him to hold the control firmly centred and without movement during the first glide."

The glider in use for this stage was designed from years of experience with a special view to avoidance of accidents, and cannot soar. It is towed over level ground for a short distance and is released when it

reaches a limited height. In this way, the pupil practises hops without much danger, even in a stalled landing, until he ceases to make false movements and can hold a steady glide. Solo instruction makes the pupil rely on himself from the beginning, while the presence of the instructor might give a false impression of competence. As the initial hops just clear the ground by a few centimetres, the instructor, from the ground, can observe the pupil closely and estimate his progress accurately.

## Dual Control

Instruction with dual control has been carried out with success, especially in clubs with a small number of pupils, for which it has certain advantages. But the greater complication of the dual control glider and the greater calls on the instructor's time prevent its adoption in schools. When a more suitable two-seater design has been evolved, dual control may become more important. At present a two-seater glider with low wing loading and a good gliding angle must have an undesirably large span and inertia.

As the pupil satisfies the instructor he is taken by slow stages further up a slope until he is able to pass the "A" test—a flight of at least 30 seconds in a given direction to a fixed landing point. From half-way up the slope he is able to practise turns, and proceeds by further stages until he gains the necessary confidence and skill to take from the higher slope the "B" test—a flight of at least 60 seconds, with right and left turns round given marks, to a fixed landing point. Twenty or thirty flights on the "Zögling" type are sufficient for the "A" and "B" tests. Towards the end of the four weeks' course the pupil is transferred to the "Prufling" and "Hangwind."

## The Advanced Class

Pilots who have had preliminary training, and who go to this school to complete their instruction, are placed at once in the advanced class, where the work consists chiefly of high-performance soaring flights, including height-gaining evolutions in regions of vertical currents. In this class the pupils generally take anything up to 50 flights, and are then ready for the "C" test. In this the chief requirement is a flight of not less than 5 minutes, in which height is continuously gained. As an indication of the skill which pupils have acquired by this time it is stated that altitudes of 200 metres to 300 metres above the starting point are not uncommon. The importance of long-distance flights is realized, and there are special courses in this phase of gliding and in cloud soaring, in which pupils often give remarkable performances.

The objects of the school are thus defined: To give sporting facilities to keen young men at small cost and thus to promote the formation of private gliding and soaring clubs in Germany; to give training during vacation to academic groups formed of students of aeronautics, and to give theoretical and practical experience to professional pilots of engined aeroplanes.

## Instruments Used

It is interesting to note that the long-distance gliders used at this school are fully equipped with instruments which enable accurate records to be kept of the performances they put up. The "Zögling" gliders, of course, are not equipped in this way, as they are simply used by beginners. On the high-performance machines, in addition to a light compass to determine the direction of path and wind, and a pitot tube for determining the air speed, there are fitted a barograph, which registers

changes in the altitude (in the case of record flights, a sealed barograph is always carried); pressure gauge and inclinometer, and a meteorograph for recording air conditions. The three latter instruments are only used on research flights.

The lectures, which are an essential part of the course, cover every aspect of gliding, both from the instructional and the technical points of view, and they are augmented by opportunities which the pupils receive of gaining insight into practical constructional work in the workshops of the school, where gliders are actually built and where repairs are carried out by the students themselves.

## A New Idea

One of the latest ideas in the training of beginners is the use of a glider (which, of course, remains stationary upon the ground) in which each control has a connection to a small electric globe. Each globe is of a different colour.

The method adopted is for the pupil to sit in the glider and to carry out the directions of an instructor who stands in front of him. As the pupil operates the controls, the electric lamps glow, and thus give a visual indication of what the pupil is actually doing. By watching them the instructor can tell at a glance whether the pupil is properly manipulating the controls. This method has no little usefulness, and will probably be more generally adopted in the future, when gliding instruction becomes more intensive as the demand for it increases.

Another method in which it is suggested that instructional work may develop is the use of wireless telephony to establish a link between the glider in the air and those who are watching its flight upon the ground.

It is, of course, out of the question at the moment to equip a glider with a wireless transmitting set. It is quite another matter to equip it with a small receiving set, which would enable the pilot to wear head-phones and to listen to instructions or any other communication from the ground. Instructional work of this kind, of course, would have to be limited to the later stages, in which the pupil had already gained full control of his machine and was embarking upon the more advanced soaring flights.

## Radio Possibilities

Such a method, too, would necessitate the use of a wireless transmitting set on the ground. This could either be permanently installed in a gliding school, or it could be a portable set for use at any given point, or for mobile use in a motor-car. The latter method would enable a glider making a long cross-country flight to be followed by a motor-car, which would be able to keep up one-way communication with it and give any information of use to the pilot. In the case of a competition flight, in which a large number of gliders were taking part, it would be equally possible for them to be given information as to their progress and that of their competitors from a central broadcasting point.

Another possibility which would be opened up by the application of wireless telephony to gliding would be the broadcasting of instructions or information to a number of gliders manoeuvring in the same area from an accompanying aeroplane. In each case, of course, this would be limited to one-way communication—i.e. from the aeroplane to the glider, the latter being able only to receive messages. At the moment the instructional application of the idea is worthy of careful experiment.

## The Plane and the Glider

What is the relation between ordinary flying on an engined plane and gliding without the aid of power? This is a question which has been discussed at considerable length by the experts, and it has provided some interesting conclusions. Many pilots of considerable experience who were trained entirely on powered planes have since taken to gliding with success. At the first of the recent gliding meetings at Itford Beacon, near Lewes, a number of English pilots took gliders into the air, and were able to put up quite a good show. The aeroplane pilot has the advantage, of course, of possessing "air sense," and is quickly quite at home in a glider. An aeroplane which develops engine trouble whilst aloft, and has to be brought down by its pilot, is simply a glider, except, of course, that it is considerably heavier than an ordinary glider would be.

The more interesting side of the question is the usefulness of gliding experience in the training of aeroplane pilots. Whilst both aircraft are similar in design, they have essential differences, and it does not follow that every trained glider pilot could immediately take an ordinary aeroplane into the air. There is little doubt, however, that the experience he had gained in controlling a glider would be of the greatest value to him when he came to take over an engined plane. The "air sense" developed in soaring has its qualities of special value, for the pilot can only keep himself aloft by the use of skill plus intelligence and observation. Every hill and every declivity offers its aid or presents its problem, and it is in overcoming the difficulties that arise almost every moment that the glider pilot gains a personal store of wisdom. With this experience the glider pilot starts his training on an ordinary aeroplane with a great advantage over the absolute beginner.

## "Air Sense"

It is said that pilots with soaring experience have proved especially skilful in the air service across the Alps, where special flying difficulties have to be overcome. The theory has been advanced that all aeroplane pilots should have a preliminary course of gliding, with the special object in view of developing an acute "air sense."

Soaring, of course, is quite possible with an ordinary plane; in fact, a good deal of useful preliminary experiment has been done in Germany with powered planes in discovering gliding possibilities. Where there has been an element of doubt, an aeroplane has been employed and has provided a lot of valuable data. The method adopted is to stop the engine of the plane for the desired experiment, the machine being then to all intents and purposes a glider, the pilot having the advantage of being able to start his engine when he has exhausted all the possibilities of the experiment in hand.

# CHAPTER V

## HOW TO ORGANIZE AND RUN A GLIDING CLUB

THE whole gliding movement, by the very nature of the sport, is bound up with gliding clubs. Gliding is as much a sport of teams as is football or cricket. The pilot of the glider is dependent on the team for launching him, and, in the case of a novice, in helping him to retrieve the glider. This co-operative effort, in which each member of the team takes his turn at each of the duties, of necessity implies a club. In this country gliding is in its infancy, and many of the pages which follow will treat of the problems which arise at the present time.

### Forming a Club

When some enthusiastic people get together and decide that they would like to form a club in their district, the usual and correct step which is first taken is to elect a committee to investigate the problem and report to the future members in due course.

The selection of this committee is a matter of great importance—enthusiasm is not a sufficient qualification. The committee should be small; five or seven is a suitable number. The members of this committee must have a reasonable amount of leisure to enable them to carry out the work and to ensure that they all contribute their share to the arduous task of formation. The qualifications are various. One member should be a lover of the country who has walked and motored to every part of the district. Another should know all the leading people. Another may well be a lawyer,

who will prevent the club making legal mistakes. Then the office of treasurer must be filled by a competent member, who will be able to control the finances of the club and guide it into a position of prosperity. The secretary must be a man of tact and promptitude, and, if he is unable to handle all the various sections of the work of the club, should have assistance by delegating the technical or the publicity side of his duties to another member, who will work under his instructions.

The first and most important possession that a club can have is a good gliding ground. There seems to be some lack of appreciation of the essential qualities of a gliding ground, consequently some space will be devoted to this all-important topic.

## The Choice of a Gliding Ground

The gliding ground must be suitable for the novice, for the trained pilot who wishes to practice soaring flight, and for the inter-club contests and those for the various prizes which are organized by the British Gliding Association.

Considering the novice stage first, the novice, even if he has had some flying in power-driven aircraft, must have a very gentle introduction to the art of gliding. A gentle slope of about one in twelve, with smooth, open landing ground, is essential. The first flights will only be of a few yards, but as the tyro progresses the length of the "hop" will be increased by small stages to the qualifying flight for the "B" Glider Pilot's Certificate. The qualifying flight for this is a flight of one minute with two bends to form a letter "S." The duration of one minute with a primary type glider, having a gliding angle which in the hands of a beginner averages one in nine, will require a length of 800 yds. from a height of 270 ft.

It follows that the hill must be between 250 ft. and 300 ft. high, with a clear slope down to the valley for 800 yds. The bottom should be level for at least 300 yds. and the top should have a gradient of about one in three.

The prevailing wind in this latitude is south-west, and may be relied on for the greater part of the year except during the months of April, May, the first few weeks in June, and in November. During anti-cyclones in summer south winds may be expected (light and variable), whilst under similar meteorological conditions in winter winds will be north or east (light and probably foggy). If the gliding ground is to be available for the greater part of the year, the north and east winds of the spring months, with their long evenings, must be considered, as well as the strong south-west winds of the remainder of the year.

The top of the hill should have 200 yds., fairly level, for the launching team. The experienced glider pilot who is practising soaring flight will require a long ridge, facing the wind, for contour sailing, and to gain altitude for cloud sailing. These rather exacting conditions are best found with chalk downs having spurs, from which glides may be made when the wind does not blow from the usual quarter.

In some parts of the country magnificent hills of over a thousand feet high may be found, which give all the requirements of the experienced pilot, but as a rule these hills have not the gentle slopes necessary for primary instruction. This problem may be met by selecting two sites, one near a town, where the novice can be instructed in his first hops, and another which will give the requirements of the glider pilot who holds the three certificates, and enable him to make cross-country flights.

## Obtaining a Site

Having selected the site of the gliding ground, the next consideration is to obtain the use of it. At present land-owners are somewhat adverse to allowing gliding clubs to use their ground, and often ask a rent which is far higher than the total rent of their farms, or the holder of the shooting rights may refuse to have any gliding on his preserves, the reason generally given being that the noise of aircraft frightens away the birds. The fact that gliders are silent is not believed.

When the club is able to do so, the best plan would be to rent the land and then sublet the grazing. In some cases the rent of grazing is higher than the rent of the land, and as the grazing is only let for a few months a gliding club with a really businesslike treasurer might get full use of many acres free of cost.

Having found and obtained the use of the gliding ground, the committee can proceed with the formation of the club. Specimen rules are given in the Appendix. These should not be adopted as they stand, but should be modified to suit the local conditions and the system on which the club intends to work. The chief point to be watched when drawing up rules is that they should be flexible, allow of easy modification, and provide for the removal of officious members of the committee without elaborate formalities. They should also provide that no member of the committee can remain in office for many consecutive years. New blood is essential if the club is to have a long and active existence. It is desirable that the council be elected each year, a rule that speedily removes "dead-heads" and very rarely removes the useful members if the elections are properly conducted by secret ballot. It is desirable that non-attendance at committee meetings and club "meets" should automatically ensure the removal of the

members who by lack of interest or lack of leisure are prevented from being useful members of committee.

## The Club Finances

There is much misunderstanding of the financial aspect of gliding. All sport costs money. The motor-cyclist has to meet considerable expenses, but people reply, "The glider uses no petrol." Quite true, but the golfer also uses no petrol, yet he has to pay for the use of the golf course, and even the wireless enthusiast, unless he is content with the local station on a crystal set, will spend several pounds a year.

The gliding club has to provide its members with the use of gliders for training purposes, has to repair them when crashed, has to pay rent for the ground, has to build a hangar and probably a workshop, and has to arrange for a permanent staff of at least one man to do repairs and maintain the gliders in an airworthy condition. It is only the clubs which face this problem with understanding which will be assured of a long and useful life.

The idea, which appears to be prevalent, that gliding clubs should be supported by donations, Government grants, or means other than the subscriptions of members and gate-money at demonstrations, lectures, fêtes, or other activities of the members, is doomed to failure. A motor-cycle club does not expect to have the cycles which its members ride given to them by donations; why should a gliding club expect such gifts? When a club is sufficiently fortunate to receive a donation at the commencement of its career, it would be well advised to expend the money on a hangar and workshop, or club room. Subsequent donations may be spent on cups or other trophies for competition among the members.

## Two Types of Clubs

There are really two types of clubs. One of these may be run at very low cost—that is, the club formed of a few enthusiasts who design and build their own machines. The costs in that case are low. The designs can be checked and approved, the machine inspected, and any advice required given by the British Gliding Association for a fee of £5 5s. on the first machine, and £2 2s. on subsequent gliders of the same type. If the designs are carefully thought out with a view to using low-priced material, two or three gliders may be produced for the cost of one standard glider purchased ready-made. Such a club will give the members the enjoyable hobby of designing, drawing-up, building, and testing their own ideas.

However, this will not be very general, because it requires a knowledge of aerodynamics, mechanics, and mathematics, which is not usually found outside the aeronautical profession, although there are a few amateurs who are capable of such work. Clubs may also buy drawings of gliders which have been approved as airworthy by the British Gliding Association, but in this case the materials are generally specified as of "Aircraft quality."

The majority of clubs will wish to spend most of their time gliding rather than in construction. The idea of designing and drawing-up every part will appear laborious to members. Because their interests are sporting rather than constructional, they want to get into the air. It is this more general type of club that has need of careful finance.

The cost of instruction is so much higher than the cost of providing flying facilities for fully-qualified glider pilots that it is advisable to separate the finance of the club into club school and club, two separate

bodies under one management committee, but with separate balance sheets. This is the more advisable because schools will be started in various parts of the country where club members may be taught for an inclusive fee and thus relieve the club of the heavy risks of crashes. The schools can provide for this by a suitable staff of aircraftsmen, which is beyond the ability of any small club. Another solution of this problem is that several clubs could amalgamate to form a joint school.

## Capital and Running Costs

Leaving the cost of instruction to be dealt with later, the club must thoroughly consider the capital and running costs which have to be met. Some of the capital charges will now be given, but it must be remembered that each club will have its own special conditions. For example, some clubs will have a large number of members who possess their own sail-planes and want them housed. The capital cost of part of a hangar to house a private member's sail-plane will be about £40, if the machines are closely packed, and considerably more if the sail-planes are to be housed separately. In general, one soaring glider to each ten members will be ample, if the club is to provide all the machines.

For 100 active members the aircraft required will be five intermediate type gliders of about 40 ft. span; two lightly-loaded gliders for soaring flights of long duration; and three sail-planes. This represents a capital outlay of £1,200, and the hangar accommodation will be about one-half that cost. Then there will be tools, hand trolleys, and general equipment, costing about £100. This will represent an annual charge of about £400 for depreciation and interest on capital.

These figures may tend to frighten anyone who contemplates starting a club. However, to reassure the reader, it may be pointed out that at the date of writing only three glider pilot's "C" certificates have been issued by the Royal Aero Club (that is, only three fully-qualified glider pilots). Consequently, some years will elapse before there are one hundred members to form even one such club. On the other hand, it is well to remember that it is clubs of this sort which will be needed when the gliding movement has taken its place as a national sport.

## Cost of a School

To turn to the instructional side of the club activities, while the members are qualifying for the sail-plane section, the whole energies of the club will be concentrated on the "school." The costs of this may be as follows, but will vary considerably with local conditions—

| FOR 100 PUPIL MEMBERS' INSTRUCTION DURING WEEK-ENDS ONLY | £ |
|---|---|
| Three primary type gliders (@ £55) | 165 |
| One intermediate type glider | 100 |
| One small sail-plane | 180 |
| Total for aircraft | £445 |
| Hangar and workshop | 350 |
| Tools and equipment | 60 |
| Total capital outlay | £855 |

| RUNNING COSTS | £ |
|---|---|
| Third party insurance (approx.) | 25 |
| Other insurances | 5 |
| Rent of gliding ground £250, less £200 for grazing | 50 |
| Obsolescence of aircraft and depreciation on equipment | 125 |
| Interest on capital | 85 |
| Salary of ground engineer, who will do repairs | 200 |
| Materials for repairs | 120 |
| Sundries | 25 |
| Total running costs | £635 |

If the 100 flying members receiving instruction pay a subscription of £4 4s., with an entrance fee of £1 1s., there will be an income of £525, leaving a deficit of £110 to be met by non-flying members, at say £2 2s., and gate charges, lectures, and other ways in which a club can raise funds if the members are keen. Some clubs make a charge for instruction, but it seems to the writers that this should be met by a reasonably high subscription.

It is advisable that the club should be registered as a limited liability company, in which case the capital may be raised by making reduced charges to those who take up shares, or else by making the holding of one or more shares a condition of membership.

## A Repairs Hint

The chief cost of instruction is the cost of repairs. It is probable that this could be kept down by making each member contribute a small donation to a fund for a prize to be given to the pilot who has the fewest repairs while learning to glide.

For the first year it is possible that a reduced expenditure on aircraft would still meet the needs of the members, in which case the hangar could be somewhat smaller, say 30 ft. by 60 ft., with provision for extension when required. In this way about £300 may be deferred from the capital expenditure at the start, to be expended as required when the membership grows.

This indication of the costs of a small club of enthusiastic workers, of a large sail-plane club, and a medium size instructional club should suffice to indicate the probabilities of any ordinary type of gliding club. The club which will attract the most members is the one which provides a horse and trolley to pull the training glider up the hills.

## Organization

The key to success in a club's finance is careful maintenance and a good system. A club that allows any member to act as instructor, and has no system to ensure that crashes do not occur, will expend all its income and capital in repairs. The organization should be such that the various spending committees are answerable to the finance committee, and if the costs of repairs increase the finance committee must inquire into the reason. Repairs must not be skimped to save money; consequently the inquiry should be to discover the reason for crashes. It should not be forgotten that skimped repairs will increase the number of crashes and result in increased costs. The greatest economy is to do all repairs efficiently with first-class material that has been stored in a suitable manner, and to take steps to trace the cause of crashes and to prevent a recurrence.

## Insurance

At the present time it does not appear to be a paying proposition for a club to insure against crashes or injury to its own members, but third party insurance is essential. No club ought to run the risk of the heavy damages which would be enforced if one member had the misfortune to land on a crowd of people. It must not be forgotten that unless the club is insured or registered as a limited liability company, each individual member is liable for the whole of the damages. Third party insurance may be effected at about 5s. per cent per annum for primary type gliders on the club ground, but rates vary somewhat. It is needless to remark that a Lloyd's policy should be insisted on.

While on this topic of risks, it is well for the club to have an entrance form for its members which protects

the club from the liability of action on the part of its members. Such a form is the one used by the Surrey Gliding Club, which is reproduced by their kind permission—

> I agree to be bound by and observe the rules and gliding regulations of the Gliding Club, and I exonerate the Gliding Club from all liability which may arise in respect of any damage to my property, or personal injury which I may suffer, while I am a Member of the Club, or participating in Club privileges, and undertake to make no claim against them or either of them in respect thereof, whether such damage or personal injury arise by reason of the negligence of any person or from any other cause whatsoever.

Care should be taken to see that any member suspended from club membership by virtue of non-payment of subscription or other cause does not attend the flying ground, because, unless the club rules are suitably drawn up, the suspended member might be able to make a claim for damage that was not covered by the third party insurance.

## Club Committees

If a club is to succeed it must be well organized, and committees must be set up to deal with each branch of the club's activities. One of the most important is the Finance Committee. This committee should meet regularly, should prepare a budget of estimated expenditure and income, and watch each month to see that as far as possible the expenditure is lower and the income higher than the budget estimate. The budget should be of the form which carries on each month's estimated and actual expenditure accumulating for the twelve months.

Suitable headings for expenditure are—

Rent.
Insurance.
Rates, taxes, lighting, heating.

Capitation fees.
Salaries.
Postages, telegrams, telephone.
Office printing and stationery.
Printing and duplicating.
Purchase of new aircraft.
Purchase of spare parts.
Purchase of accessories.
Purchase of materials for repairs.
Additional labour for repairs.
Various expenses in connection with repairs.
Transport, fares, cartage, in connection with repairs.
Demonstrations, competitions, and lectures (publicity and printing).
Demonstrations, competitions, and lectures (rent of hall or grounds).
Demonstrations, competitions, and lectures (salaries and fees).
Advertising (general).
Depreciation on aircraft.
Depreciation on other property.
Travelling expenses of staff or delegates.
Sundry payments.
Interest on capital.

For income—

Rents received, sale of agricultural produce.
Entrance fees.
Subscriptions.
Donations.
Fees received.
Gate money (meets).
Gate money (lectures or demonstrations).
Flying money.
Disposal of obsolete aircraft or parts.
Advertisements displayed.
Various.

A finance committee which will take the trouble to get out a budget, keep the expenditure down on each item, and explore each avenue of possible revenue, will make a club twice as wealthy as one with similar subscriptions run on haphazard lines.

Meetings of the whole committee should be held in the second week of each month, so that the budget can

be presented and the actual financial position of the club noted by all members. This also assists the annual audit.

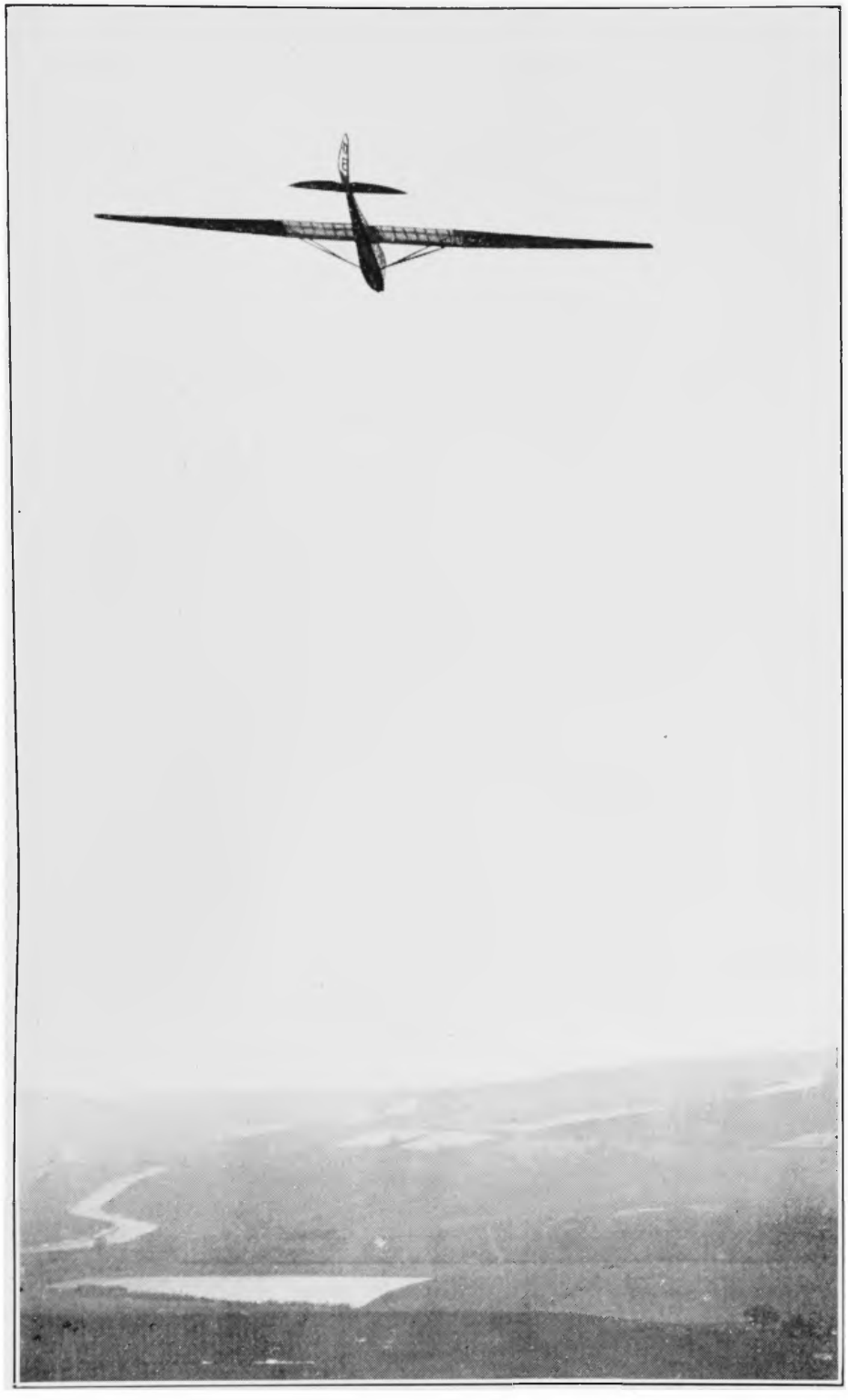
## Care of the Ground

The next committee in order of importance is the Ground Committee, whose duty is to keep the ground in order, to negotiate with landlord or tenants, to dispose of hay or grazing, keep fences in repair, arrange for the "gate" at demonstrations or competitions, and to see that the club buildings are in good repair. At this point it may be remarked that many pounds' worth of damage to aircraft may be avoided by a few shillings spent promptly on the roof, the floor, or the heating apparatus. Aircraft of any type can be easily damaged by damp, and this applies more especially to gliders of the advanced types.

## Maintenance and Inspection Committee

Then there must be a Maintenance and Inspection Committee to supervise the repair and building of the club aircraft. As far as possible, the members should hold technical qualifications, not as pilots but as engineers, architects, or even woodworkers. The club ground engineer should be answerable to this committee, and in turn the committee must be answerable to the club for keeping the aircraft in a proper airworthy condition. Shoddy repairs, to save time, are nails in the pilot's coffin. All work should be the very best possible. A glider has to be able to sustain very high stresses in the air, and very heavy shocks on landing. Only the best material and workmanship will ensure safety. Good workmanship and good material do not necessitate great cost; they only necessitate great care and reasonable routine.

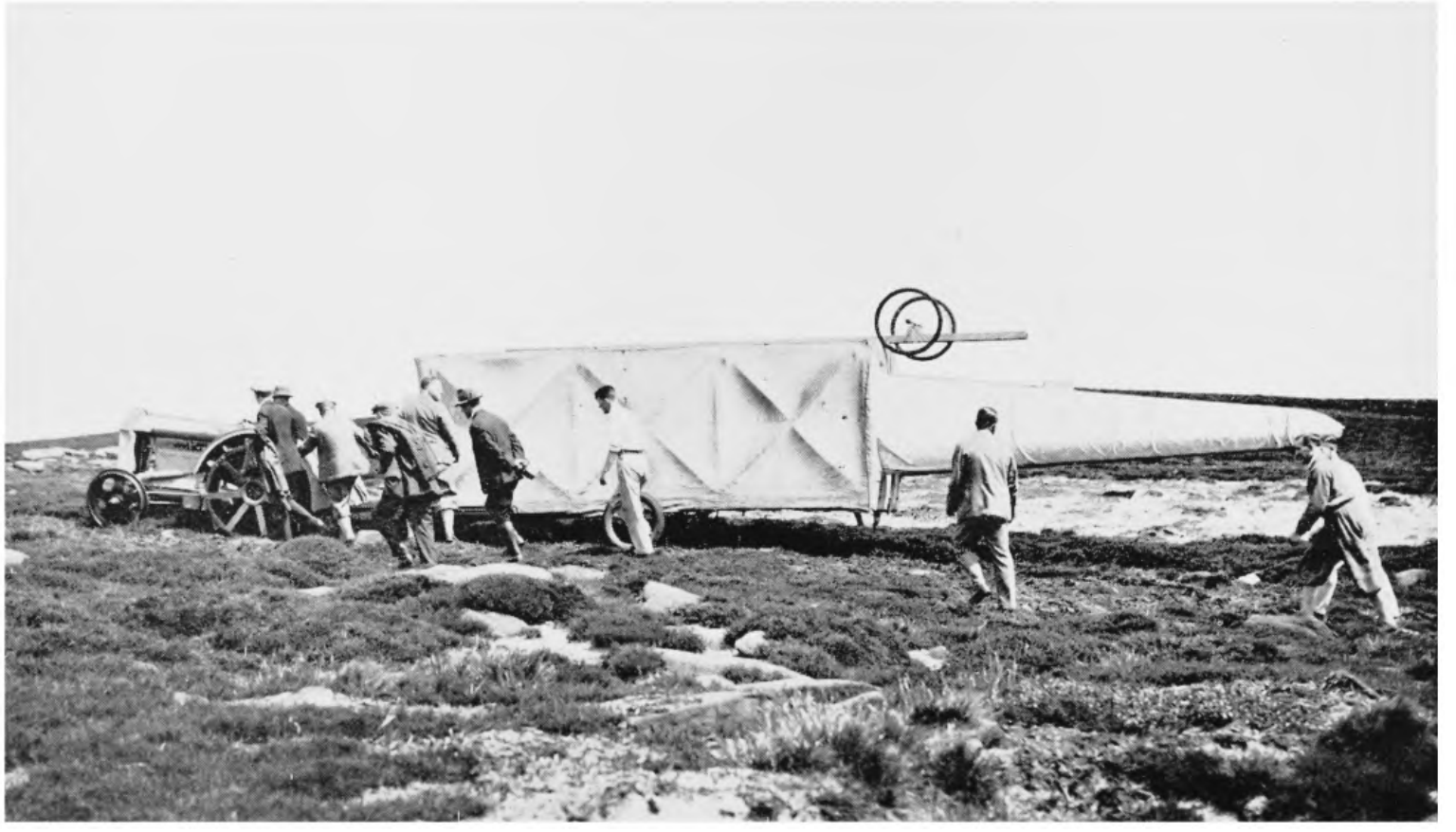
PLATE XIX



A Sail-plane Over the Sussex Downs

*Photo : "Daily Express"*

# PLATE XX



How a Modern Glider is Transported

Herr Kronfeld's "Wien" being drawn by a tractor across the Yorkshire moors

*Photo: "Yorkshire Post"*

The hangar must be kept clean and tidy. The workshop must have a place for everything, and everything should be returned to its place at the end of a day's work. The amateur workers who intend to build and repair gliders must be under the control of this committee.

The reader will probably be thinking that although this book is about gliders, so far he has read only about pounds, shillings, and pence, about buildings and farms, but nothing about gliding. If the reader were buying his first motor-car, his initial consideration would be where he could keep it, and what would it cost to run. In the same way, before a gliding club buys its first gliders, it must consider where it is going to use the gliders, where they are to be housed, and what they are going to cost.

## Flying Committee

Now we will consider the Flying Committee. If possible, get one or two old aircraft pilots, with experience of pre-war machines (some of the old "Box-kites"), to act on this committee, even if only in an advisory capacity. It will be well if they recall memories of the old 50 h.p. Gnome-engined biplanes, or 28 h.p. Anzani-engined Bleriot monoplanes. Those old machines taught the pilot to keep the nose down on a turn, and to push the "joy-stick" forward when in difficulties.

It is advisable that one or two members of this committee should have gained their "A" and "B" Glider Pilot's Certificates before the club starts work, and if they are taught at a school, even if it means going to Germany, it is the better plan. The cost of instruction is quickly saved in the reduction of crashes. Unless the club can afford a paid instructor, one member of this committee must be in charge whenever instruction is

given, even if it is a "B" ticket man going for his "C." Some rules proposed by the British Gliding Association clearly indicate the responsibilities of this committee and the Maintenance Committee. These can easily be obtained.

# CHAPTER VI

## CHOICE OF GROUND AND CARE OF GLIDERS

THE possession of a good gliding ground does not of itself mean that the club has all that is necessary. It is necessary also to have a good knowledge of the air currents over the ground for all winds which can be used. By way of explanation, it must be said that the glider must always be launched directly against the wind, and at the same time directly down the slope.

In most cases, the club will have a choice of slopes to suit various winds. A hill to allow of this will be of the form of a bowl or several spurs. If the wind is in such a direction that the gliding path is to one side of the bowl, or half-way along a spur, the line of the gliding path will be similar to that shown in Fig. 8, in which it will be noticed that the wind comes over the end of the bowl or other spur and forms an eddy at the point. If an experienced pilot is launched from the top of the hill, his flight-path will take him clear of the eddy into the down draught, where he will make a somewhat sudden, perfectly normal landing; but a beginner, launched lower down the hill, must pass through the eddy. This will very possibly cause complete loss of control, with a crash, which, if it does no harm to the pilot, will most certainly cost the club £10 or £15 in repairs. To obviate this sort of crash, which accounts for about half the damage done to gliders, it is essential that the gliding ground be explored by means of a smoke-rocket or free air-balloon, or, probably, a small box-kite on a short string would be useful.

## Beware of Eddies

There is a diagram in the *Journal of the Royal Meteorological Society* giving a case of such an eddy which held the balloon for four complete turns of the eddy before releasing it. A glider, which got into the same eddy at the same place a few years after, was completely wrecked, and the pilot was somewhat shaken.

For this reason, the ground should be explored every time gliding is to take place, and the result of the exploration noted on a chart, until sufficient data is obtained to give certainty as to the condition of the air for any direction of the wind. These eddies will be found to be surprisingly constant.

The club should have a "stocking" flying, and should test the wind velocity before flights are attempted. Beginners should not be instructed in winds in excess of 25 m.p.h. or less than 10 m.p.h. On days when the wind is very gusty and changeable, it is advisable to suspend flying except for glider pilots holding a "C" certificate. At the German schools instruction is only given when the meteorological conditions are exactly right. This saves much damage to machines with attendant expense, but often causes delay of weeks.

Considerable time will be spent in the preliminary arrangements of the club's formation. During this time the proposed gliding ground may be tested from day to day under various meteorological conditions. Such work, started at the earliest possible minute, may save the choice of an unsuitable gliding ground or may indicate where the hangar can be placed to avoid putting it where it will be at the mercy of excessive wind pressure in a gale, which would mean difficulty with the roof.

## Position of the Hangar

The hangar should be placed at the bottom of the hill and near the entrance for primary and secondary types of machines which land at the bottom of the hill. For sail-planes, the contrary holds good, because this type of glider should always land at the top of the hill.

Some clubs will cater only for the pilots of sail-planes and thus give no instruction, being content to leave this to the schools or other clubs. Such clubs, by limiting their membership to those already holding Glider Pilot's "C" Certificates, will not require to pay attention to the primary type glider, and may cut out the heavy charges for repairs in the specimen budget.

It would cost a novice about £50 to go to Germany and stay at a school until he obtained his "C" certificate. When schools are started in this country the cost would be about a quarter of this. The club which teaches beginners saves its members this cost, but has to take the risks of damage to its aircraft.

## Preparing a Glider

The following hints are written for a club or a private owner who has purchased a primary type glider as the first machine, and is presumed to have no previous knowledge of any type of aircraft.

Gliders are aircraft, a fact which is sometimes overlooked by club members. Aircraft are constructed to be as strong as is compatible with lightness. The result is that, if one part is in a damaged condition, the strength of the whole structure is reduced.

All types of gliders must be maintained in an airworthy condition. The failure of a wing or other essential part of a glider is as likely to cause loss of life as the failure of the same part of an aeroplane. Every

club has a duty to its members—the duty of seeing that the gliders are in a perfectly airworthy condition before they are allowed out of the hangar. In the case of clubs that design and make their own gliders such a general warning is all that is required. On the other hand, for clubs whose members are not familiar with the maintenance of aircraft, the following procedure should be carried out.

## Erecting the Glider

On receiving a glider from the makers, clear the floor of the hangar. Set up the fuselage or body level and upright. Two men should stand, one in front of the main spar fitting and one behind the rear spar fitting, each steadying the fuselage with one hand and holding the fixing bolt in the other. Four men should now lift the plane carefully by the spars, two at each end. The man at the extremity of the rear spar must hold the aileron to prevent it hanging down at the risk of damaging the hinges. The two at the wing tip must hold the plane until both planes are erected and all wires, including the control wires, are connected up. The butt ends of the spars should be offered up to the fittings on the fuselage, and the bolts inserted, care being taken to hold the plane so that the bolts enter the holes easily, without forcing.

The two men who were holding the butt end of the spars should now unroll the wires hanging from the centre pilon or fin, unscrew the barrels from the turnbuckles, and then screw them on half a turn only. The other screwed end of the turnbuckle, which is attached to the plane by a short wire, should now be offered to the barrel, and the turnbuckle screwed up two or three turns only. Care must be taken to see that both screws are entered in the turnbuckle to the same length. The

plane will now be hanging from the wires, but the men holding at the wing tip must continue to support the plane and prevent the aileron from hanging down. The same procedure is now undertaken for the other wing. Next, the flexible control wires to the ailerons should be connected up loosely, and the wings supported on the fuselage. The wires underneath must now be connected up loosely.

## Truing Up the Wings

The wings must now be trued up. If the hangar floor is good and level, this may be done by measurement from the floor. Unless the manufacturer has given instructions to the contrary, the angle that planes make to the floor should be the same throughout their length, from tip to tip. This means that the height from the leading edge to the floor must be the same at all points; the same applies to the trailing edge, though the height of the latter will be less than that for the leading edge.

The wires underneath the plane may now be tightened. This must be done carefully, because it is these wires that support the glider in the air. See that the screws enter the barrels of the turnbuckles equally, and do not tighten these wires too tightly. They should be just tight, so that if the glider is lifted at the points at which the wires are attached to the planes the top wires do not slack off appreciably. Anything more than this will produce unnecessary stresses in the spars.

When the wires are true, the turnbuckles must be locked by pieces of copper wire of about 20 gauge, by passing the wire through the hole in the centre of the barrel and through each eye, the surplus end of the wire being wound round the turnbuckle. About 5 in. of wire is a suitable length.

## Fixing the Tail Plane

The tail plane may now be fixed to the bolts provided, care being taken to offer it up gently without forcing the bolts. The wires from the planes to the rear of the fuselage must be uncoiled and lightly screwed up, always taking care that the screws are entered equally in the barrels of the turnbuckles. The number of wires varies with the make of glider; some have four and some have eight wires. These wires must be tightened gently until the fuselage is true, upright, and square with the planes. These turnbuckles should now be locked. The elevators and rudder may now be placed on the hinges.

Take care to fit the split pins, or safety pins, supplied to prevent the elevator or rudder sliding off the hinges, or the bolts or pins dropping out.

## The Controls

The control wires should be connected up. *Do not forget that the elevator wires are crossed.* When the wires are connected up, set the "joy-stick" central and upright; then adjust the wires so that the ailerons are level with the trailing edge of the wings, that the elevator flaps are in line with the tail plane, and that the controls move smoothly. Move the "joy-stick" forwards and backwards, and see that the elevator drops down as the stick is moved forward and rises as it is pulled back; that when it is moved to the right the left aileron drops and the right one rises, and vice versa. There must be no "slack" in the wires, but they must not be tight enough to make them run stiffly.

Lock the turnbuckles in these control wires as carefully as the main bracing wires. The rudder wires may now be connected up and adjusted, so that when the

rudder-bar is square the rudder is straight. When the left foot is pushed forward the rudder must turn to the left.

## Inspect the Wiring

The wiring must now be inspected. It is a good plan to write down every turnbuckle and every bolt that is used in erecting the glider, and then to check each from the list to see that it is properly locked. Try also each wire for tension to see that it is neither tight nor slack. Observe carefully that the controls do not foul anything at any part of their travel.

This careful checking must be carried out before each day's flying, and the wires should be checked for tension after each heavy landing. It will be found that a new glider requires to be "trued-up" very frequently, but after a time it will settle down and keep true for several flights.

The method described is for a primary type glider, which is the first glider to be owned by any club. The more advanced types of gliders are braced in a simple manner, and, as the club members will have more experience and will probably have a qualified ground engineer, there is no need to describe the method of erecting and truing them. *The same careful inspection of all bolts, hinges, and turnbuckles must be maintained.* A glider receives much harder wear, both in the air and on the ground, than the average aeroplane, and must be looked after more carefully.

# CHAPTER VII

## PRACTICAL GLIDING: INSTRUCTION AND ACTUAL AIR WORK

WHEN possible, every club should have an instructor, honorary or salaried, who has had a proper training, but, as many clubs will be formed in places where this is not possible, some practical advice will be of use. The fact that a member has had experience in flying power-driven aircraft must not be taken as any reason for omitting the preliminary stages of instruction. Those pilots who had considerable experience 16 or 20 years ago, and have flown a great variety of aircraft of early types, may have an advantage over raw beginners. The ordinary "A" certificate pilot, who has only had a few hours on modern light aircraft, may have greater difficulty in learning to glide than those who have had no previous experience.

### Instruction Methods

The instruction should take place on the level, or, better still, on a very slight slope facing a steady wind of 15 to 20 miles per hour.

Carry the glider out of the hangar to the selected place. A glider must not be held just anywhere, or parts will be bent or strained. Carry the glider by the skid, by the points of attachment of the main lift wires, by the extremity of the tail booms in the "American" type, or by the girder in front of the tail plane in the "Zögling" type. Do not lift by the wing tips or by the tail plane. When holding the wing tips to steady the machine, hold at the spars not in between them. If the part you are holding seems to bend, do not

continue to hold at that point. Manufacturers of gliders ought to paint "Lift Here" at suitable points, and clubs will be well advised to insist on this being done before delivery.

Having placed the glider in position, two members must be detailed to hold the wing tips, to steady the machine, by holding at the spars. These two members, having undertaken this duty, must not leave the glider. On more than one occasion a new glider has been blown over and damaged. Two members must also be detailed to hold the tail back until the word to release.

The launching cord supplied with the glider is now hooked on to the front of the skid. It will be found that the ring will not stay on the hook until a slight tension is applied to the cord. The hook must not be curved; it should be almost straight, to ensure release at the moment the glider is well in the air. The pilot should be strapped in and his feet placed on the rudder bar in readiness.

## Launching the Glider

Two men should take hold of each end of the rope (four in all), and stand so that the angle between the two halves of the rope is 30 degrees; that is, with the usual 60 ft. rope they should be 30 ft. apart. Take care that the glider is exactly facing the wind, and that each rope has the same angle to the glider. The launching team should have two points to run to, in line with their ropes, so that the angle increases as they run. The instructor, who will give the commands to the team, should stand on one side, about 10 ft. in front and 20 ft. to one side of the glider.

The cord being just tight, so that it stays on the hook, and all being clear, he gives the word "Run." The launching team runs, until the tension of the rope

begins to slow them up, i.e. when the rope has extended to one and a half times its length. The word "Release" is now given. The members holding back at the tail let go instantly and at the same time, while the team make an extra effort in running. The glider will then shoot forward and leave the ground. The rope will fall off the hook, and the team should stop running.

## A First "Hop"

This first flight should only be a few yards—just a "hop." It is important to rehearse the action of the launching team several times before the actual word to release is given to ensure that they know what they ought to do. It is important that they should be on the alert for the command, "Drop the rope," because sometimes the launching cord does not come off the hook, and if the rope is not released the glider will be dragged to the ground and have a nasty crash. The cause of this is always that the angle of the rope between the two teams is too great, or that the hook is too curved. The members at the tail of the glider can generally see the fault more easily than other people

The pilot should hold the "joy-stick" central and the rudder straight, in which case the glider will come to the ground, after a low hop of a few yards, without a shock. It is as well for the first few attempts that the glider should not leave the ground for more than, say, 5 yds. in length, until each member knows what to do.

## A Common Fault

The acceleration at the start often causes the pilot to pull the stick back involuntarily. This causes the glider to rise too rapidly, resulting in a stall (the glider loses flying speed), and a bad landing results. One of

the chief reasons for insisting on such gentle starts is to watch for this universal fault, which is more prevalent with members who have driven power-driven aircraft than with novices.

Remember, there is no engine to give power and to enable the pilot to "zoom." All the power is due to gravity and the wind; therefore, the pilot must put the nose down to get power to overcome obstacles or to gain speed for any sort of manoeuvring.

At the start of any club it is advisable to concentrate on two or three likely pilots for the first two or three afternoons, in order to train the members in their various duties. The members should take turn and turn about in all positions except the pilot's seat.

It must be remembered that, if one member of the launching crew falls down, the glider will be jerked sideways, and will probably crash. This is one reason why the launching team must be ready for the command to "Drop the rope," which will stop the launch before the glider has sufficient speed to do much damage.

For clubs which are starting with no previous experience of any form of aircraft, the launching team, and for that matter the pilots, may have some preliminary training on a dummy glider. This will be a small toboggan with two runners about 8 ft. long, having a dummy glider skid and seat, a mast for the pilot to lean against, a rudder bar free to swing, and a "joystick." The launching crew should be increased to three or four on each side, and the same procedure followed as for launching a glider. This will enable practice to be had without crashes or repairs. Of course, the dummy will not leave the ground, but it will accustom the members to some of the conditions of starting to glide.

## A Longer Hop

All beginners should be launched gently as described, but the more advanced pupils may now try a longer hop. The glider may be taken a little higher up the hill and the same procedure followed, and progress made step by step until flights of 20 seconds are made easily. If there are any crashes they will be found to be due to allowing the pupil to advance too rapidly, or in some cases it may be found to be impossible to teach the member to refrain from moving the controls violently. On most gliding grounds flights of 15 seconds may be made without moving any of the controls. Crashes may also be due to the launching team not running equally and in the correct direction.

The successful club is the one which curbs the enthusiasm of its members and by going slowly avoids crashes, which cause expense and delay. It will not save time to push a pupil on too quickly and then have a crash which may take longer to repair than the time required to go slowly and carefully.

The beginners who have not done a 20 seconds' steady glide should be kept in a group for instruction by easy stages, and should take turn and turn about at the pilot's seat and in the various positions in the team. It should be a rule that no member may sit in the pilot's seat unless he does his fair share of pulling the glider back up the hill, running in the launching team, holding back, or giving the commands.

The members who have passed the 20 seconds' test will wish to qualify for the Glider Pilot's Certificate "A." These should take the other glider belonging to the club, and increase the length of the hops, each member taking three consecutive turns at piloting.

When the club has got started, it should apply to the British Gliding Association for observers to be

appointed by the Royal Aero Club. The names of these observers must be put forward for approval by the club, and about a month allowed for consideration. The conditions for the issue of the certificates are in the appendix.

## The " B " Test

After the members have obtained their "A" certificates they will try for the "B" certificate. This will necessitate taking off from the top of the gliding ground, and, unless the wind is fairly strong, there may be difficulty in getting the one minute duration; but if the hill is really suitable, and the wind is 20 miles per hour or more, there should be no insuperable difficulty in getting one minute duration from 200 ft., with suitable turns. The glider must be kept at its most efficient gliding speed. This requires skill and the "air-sense" which is necessary before soaring flight is possible. It requires practice and skill to find the lowest sinking speed without stalling. It should be remembered that the lowest sinking speed is not the slowest flying speed, and sometimes putting the nose of the glider slightly down may reduce the speed of descent.

## The " C " Test

If the gliding ground is a really good one, the "C" certificate may be taken on a "primary training machine," under favourable conditions; that is, a steady wind of, perhaps, 30 miles per hour. It is usual in Germany to qualify for this, the most advanced certificate, on a "Zögling." There the teaching is very thorough, though often held up by the weather, because no instruction takes place unless the weather conditions are just right.

If, however, the gliding ground is not good, it will be

necessary to use the intermediate training machine for the "C" Glider Pilot's Certificate. This glider has a finer gliding angle, is heavier, with a higher loading per square foot on the planes, and consequently lands faster and can be flown in higher winds. When starting to use this glider for the first time, the same care should be taken as with the primary type. Three men will probably be required at each end of the launching rope. The controls are more powerful and more care must be exercised in learning to fly it, but it will be found a much more pleasant machine to fly. Considerable practice should be gained on this intermediate type before proceeding to the sail-plane, the most advanced type of glider.

There is no need to deal with the advanced stages of gliding in this chapter, because when the club has a few "C" certificates it will be fully established, and will be able to enter some of the inter-club competitions, where interchange of ideas will correct any minor errors of procedure.

### Future Developments of the Club Movement

It is a very dangerous thing to prophesy, but there are already signs that the club system in England will develop into something more than enthusiastic members teaching each other to glide during week-ends (when the glider is not under repair).

The instruction of novices is a wearisome task for club members who have gained their three Glider Pilot's Certificates. It will be found necessary to keep the instructional work quite separate from the proper work of the club, which is to provide facilities for the members to indulge in the sporting side of motorless flying: that of cross-country, altitude, and duration flying and cloud-sailing.

It is probable that each club will have small competitions each week-end, in addition to the larger inter-club contests. This must lead to a separation of the instructional gliding from sail-plane flying. This means there will be schools of gliding. A large club may have its own school, or several clubs may combine to form a school, or, on the other hand, a school may be started as a profitable concern. In any case, the glider pilot will enter the club with his three certificates, and the club will be freed from the necessity of having to provide primary type gliders and facilities for undertaking the many repairs.

## Club of the Future

A club formed for qualified pilots will have a very different organization from that discussed already. The gliding ground will very likely be chosen in some part of the country remote from a town, accommodation being provided for members to spend several days or weeks in the club-house. The management of the club will be on the lines of a yacht club.

Hangars must be provided for members' sail-planes, and the staff will include a launching team or some mechanical catapult. A breakdown lorry will also be necessary to retrieve the over-ambitious cross-country pilot who, in his eagerness to reach some objective, fails to hold his wind and makes a forced landing.

For the club which wishes to start its own school, flying seven days a week, one suggests a primary type glider for each five pupils, and that pupils be grouped in flights of 10, using one glider and holding the other as reserve. Facilities should be provided for repairing, which may be estimated at one complete glider for each five "A" Glider Pilot's Certificates.

It is advisable that the pupils should do some work

in the repair shop, so that they become familiar with the construction of gliders and learn to appreciate the need for proper maintenance. Lectures may be given on "Contour-sailing" and "Cloud-sailing." With average weather, the "C" certificate may be gained in about a month's course.

# CHAPTER VIII

## TYPES OF GLIDERS EXPLAINED

In this country all motorless aircraft are called "gliders" if they are heavier than air, and are not assisted in flight by the occupant of the glider. It is, perhaps, a term which is rather misleading, as it is generally considered that "gliding" is a method of tobogganing down a hill a few feet above the ground. There is, however, no reason why this idea should be associated with the term, except that until recent years no one had made a glider capable of really sustained flight. The word "gliding" very clearly describes the smooth flight of a sail-plane, which is more truly flying than the noisy rush of the power-driven aircraft, which must have a 20 or 30 horse-power engine to accomplish the same flights as can be made on a good sail-plane in the hands of a very skilful glider pilot.

Gliders may be divided into four types: the primary, or training, glider; two types of intermediate gliders, one of them with streamline fuselage and moderate loading, the other with open tail girder and light loading; and the sail-plane.

### The Primary Type

The most familiar example of this type, the primary training glider, is the "Zögling," made at the Kegel Factory at Cassel, Germany. The leading dimensions are—

Span, 32 ft. 9 in.
Length, 17 ft. 9 in.
Area, 170 sq. ft.
Aspect ratio, 6¼.
Weight, empty, 189 lb.
Weight per sq. ft. with 160 lb. pilot, 2·05 lb.
Best gliding angle, 1/11 at a flying speed of 28 m.p.h.

This glider is made without any attempt to reduce head resistance by streamlining, except for the shaping of some of the struts behind the pilot, which is quite ineffective, because these struts are shielded by the pilot. It would be much better to make these of full section, to avoid the weakness which results from the reduction of section at the point of greatest stress. The

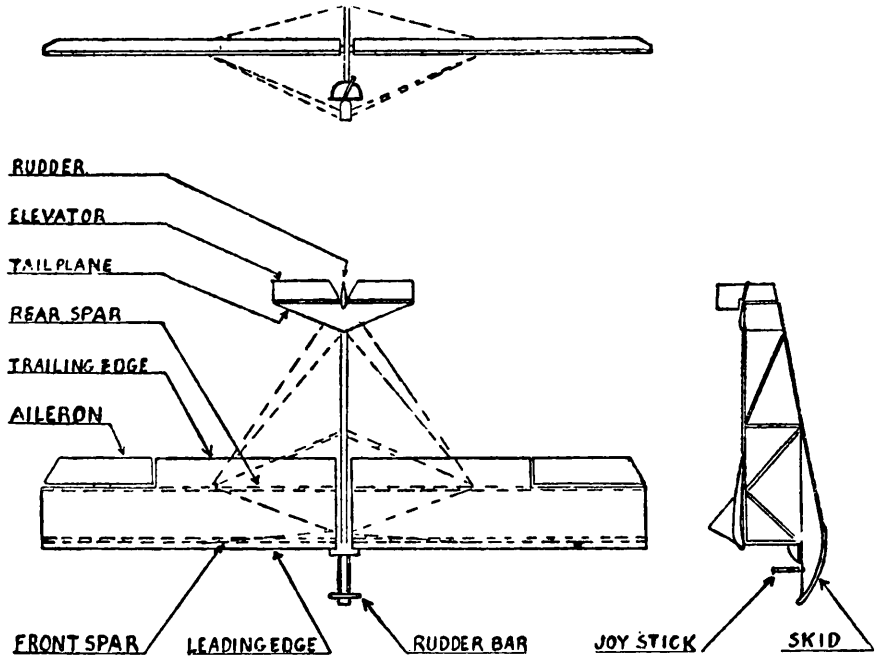



FIG. 1. PRIMARY TYPE GLIDER

pilot sits exposed, which reduces the gliding angle to about 1/10.

This type has many advantages over the more conventional type of glider for instructional purposes. Some of the advantages are: If the belt is strong and securely fastened, the pilot is protected from contact with the ground whatever the position of the glider when it strikes the ground in a crash, whether it be normal, upside down, on the point of the skid, on a wing tip, or on the point of the skid and the wings at the same time. Another advantage is that it accustoms

A PRIMARY TYPE GLIDER JUST AFTER TAKING OFF

This glider, made by members of the Kent Gliding Club in five weeks, was the first Primary type glider to be flown in England

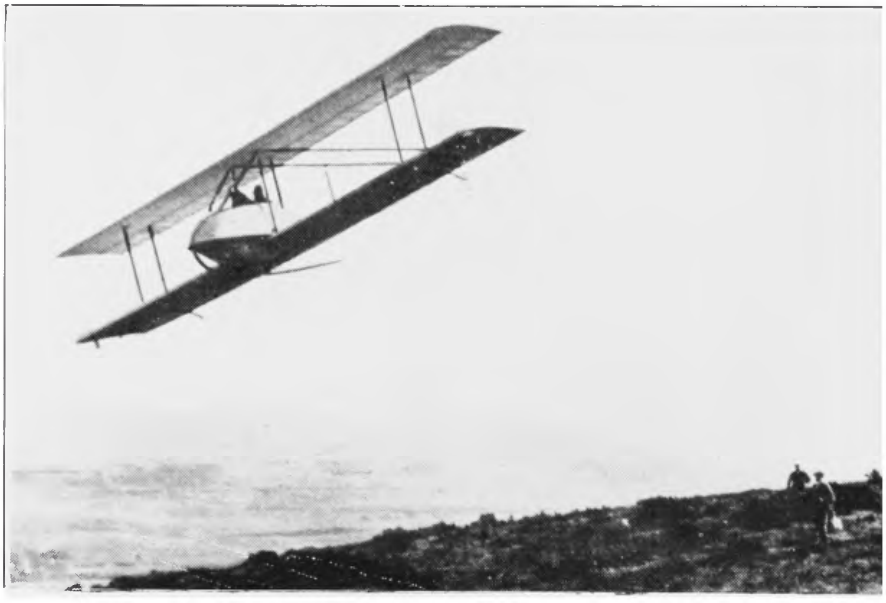
*Photo : "Portsmouth Evening News"*

A SECONDARY TYPE GLIDER

This Prüfling glider was flown at West Firle, near Lewes, by Captain L. Needham, of the London Gliding Club

*Photo : "Portsmouth Evening News"*

# PLATE XXII



THE FOKKER BIPLANE GLIDER, 1922

AN AMERICAN GLIDER, 1930

the pilot to being supported by the air, and produces that "air-sense" which is so essential for soaring flight. Furthermore, repairs can be carried out expeditiously and at moderate cost.

The chief drawback is that the general design does not permit of the modifications which would make it portable and easy to rig. The sixteen wires on the German-built machine make dismantling and rigging a slow and difficult operation to those who are not used to such work.

A modification of this type, made by the R.F.D. Co., Type A.T., has several advantages in rigging, and, as one of these made a soaring flight of about 20 minutes at Itford in 1930, it is probably more efficient.

This type is, of course, the primary training type, and is only of interest to the beginner up to gaining the "B" Glider Pilot's Certificate. Consequently, the ease with which it can be repaired, and also its safety, more than compensate its obvious drawbacks.

## Intermediate Type

The intermediate type of training glider is in appearance and construction very similar to power-driven aircraft. Several of the high wing monoplanes of France and the U.S.A. have very similar dimensions, and it may be compared to a normal type of two-seater aeroplane, in which the pilot sits in the position usually occupied by the engine. The best-known glider of this type is the "Prufling," made at the Kegel Factory at Cassel, Germany. The leading dimensions are—

Span, 32 ft. 9 in.
Length, 17 ft. 9 in.
Area, 164 sq. ft.
Aspect ratio, 6½.
Aerofoil section, Gottingen 549.
Weight, empty, 231 lb.
Weight per sq. ft. with 160 lb. pilot, 2·39 lb.
Best gliding angle, 1/14 at a flying speed of 30 m.p.h.

This glider stalls more readily than the primary type, and, having a comparatively high loading, is only suitable for soaring flight in a brisk breeze. It is difficult to repair after a moderate crash; consequently, if any clubs use this type of glider, it should be reserved for experienced glider pilots. It is capable of sharper turns

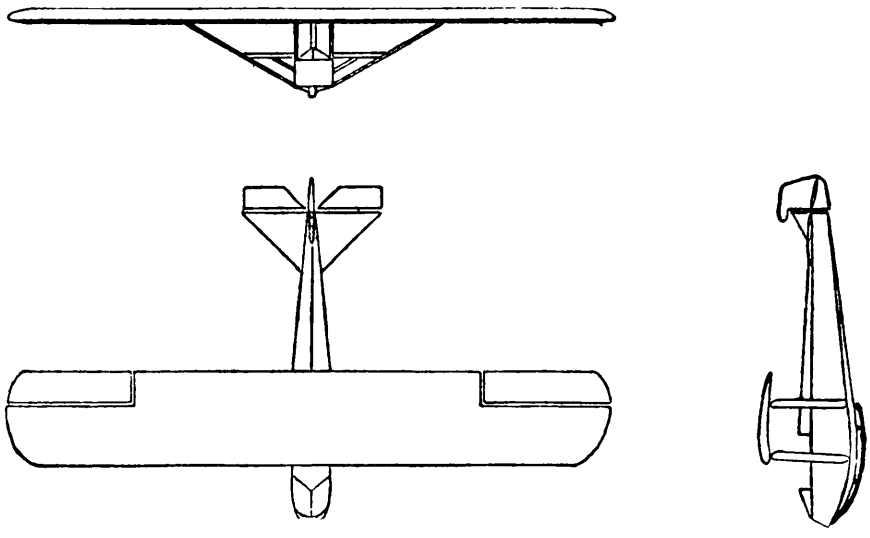


FIG. 2. INTERMEDIATE TYPE GLIDER

than the "Zögling," and is more controllable. Its performance is similar to that of the British gliders which entered for and flew in the *Daily Mail* competition at Itford in 1922.

The other type of intermediate training machine is replacing the "Prufling" in Germany. A typical example of this is the "Hangwind," which is in appearance similar to the "Zögling," but the pilot is seated in a small streamline *nacell.* The leading dimensions are—

Span, 39 ft. 4 in.
Length, 21 ft. 4 in.
Area, 200 sq. ft.
Aspect ratio, 7¾.
Aerofoil section, Gottingen 532.
Weight, empty, 189 lb.
Weight per sq. ft. with 160 lb. pilot, 1¾ lb.
Best gliding angle, 1/13 at a flying speed of 26 m.p.h.

This type of glider is very suitable for the English meteorological conditions, for it must be remembered that the present type of glider which has been developed in Germany is designed for somewhat stronger and more steady winds than prevail in the south of England. This type of intermediate glider is easier to repair, and

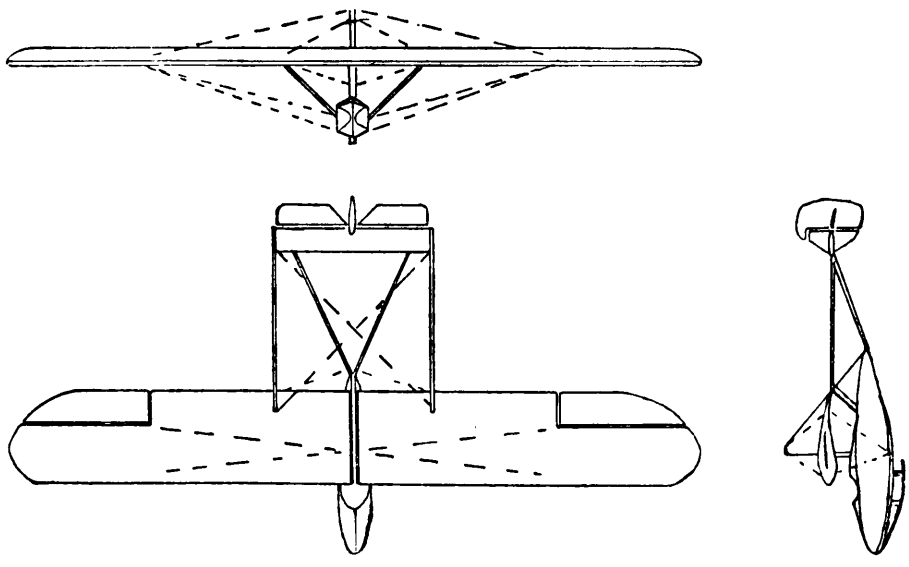


FIG. 3. ANOTHER INTERMEDIATE TYPE GLIDER

somewhat less likely to serious damage, than the "Prufling" type.

## The Sail-plane

The sail-plane is the true soaring glider. All the machines described up to this point are for training the would-be glider pilot. The sail-plane is the glider on which long cross-country flights can be made, and cloud-sailing indulged in. The sail-plane is a fairly modern type of aircraft, and it is only within the last five years that aircraft of this type have been available. The type is being improved very rapidly, and there is an obvious indication that the general design will be modified. There are two directions in which improvement

may be expected: the simplification of construction, to enable the cost to be reduced, and portability. The aerodynamic design will probably be somewhat improved, but it is already so far advanced that great improvements in this direction are not very likely to take place.

The definition of a sail-plane is taken as "a glider which has a sinking speed of less than ·8 metres per

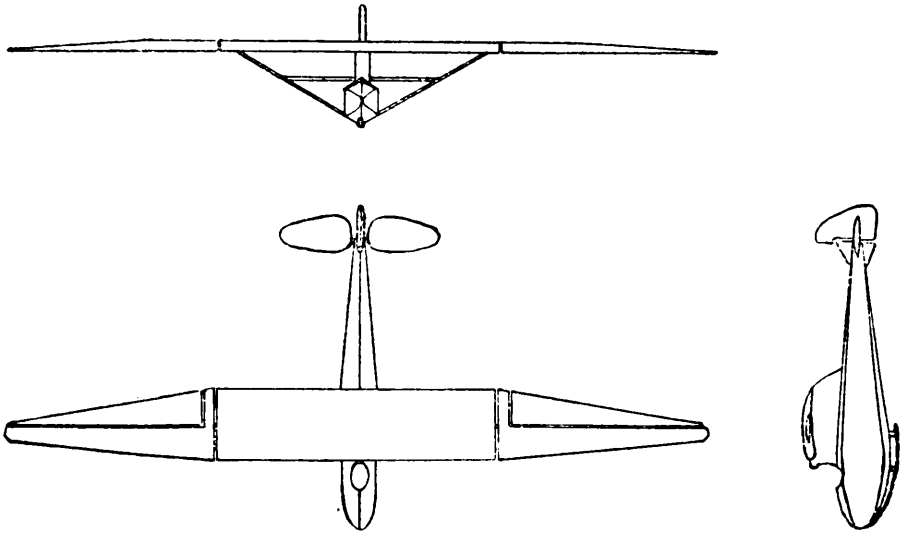


FIG. 4. THE SAIL PLANE

second." That is, in simple language, that the machine will soar in a wind which is rising vertically upwards at a speed of $1\frac{3}{4}$ miles per hour. An intermediate type glider requires almost twice this wind.

The leading dimensions of the "Professor" sail-plane are—

Span, 52 ft. 9 in.
Length, 23 ft. 1 in.
Area, 200 sq. ft.
Aspect ratio, 13.
Aerofoil section, Gottingen 549.
Weight, empty, 340 lb.
Weight per sq. ft. with 160 lb. pilot, $2\frac{1}{2}$ lb.
Best gliding angle, 1/21 at a flying speed of 45 m.p.h.
Sinking speed, 26 in. per second.

Other sail-planes have been flown at the competitions which are held each year at the Wasserkuppe which have considerably higher performance than this machine, but these were experimental gliders, built by the various German gliding clubs which had the necessary technical ability.

To obviate any misunderstanding: the sail-plane is not an aircraft fitted with any special devices or of any special form; it is a glider which is so efficient in its aerodynamic properties that it has a sinking speed of less than ·8 metres per second. An efficient power-driven aircraft has a sinking speed of about 6 metres per second, nearly eight times greater.

## Strength and Load Factors

The strength of a glider must be adequate. It is essential that the glider pilot be protected from the risk of a failure of any part of the glider while in flight, or in a normal landing. It must not be supposed that because a glider has no engine the stresses are necessarily lower than in a power-driven aircraft. The researches conducted in Germany (see the *Journal of the British Gliding Association*, No. 1, Fig. 23) show that a sail-plane can be subjected to very violent stresses when cloud-sailing, and as the best weather for sail-plane flying is often during the high winds of the winter months, when the aeroplane pilot prefers to leave his machine in the hangar, the question of adequate strength is of fundamental importance.

The load factors required by the British Gliding Association are—

MAIN PLANES

| | |
|---|---|
| C.P. forward | 5 |
| C.P. back | $3\frac{1}{2}$ |
| Nose dive | 1 |
| Inverted flight | 3 |

TAIL PLANE
To be of strength comparable to the main planes.

FUSELAGE
4

LANDING GEAR
4

Application should be made to the British Gliding Association for full particulars.

## Not Excessive

These values are not at all excessive, and correspond to the German sand load of 6. It will be noticed by technical readers that the C.P. back case is indeterminate for gliders, but if a speed of three times the stalling speed be taken, it will certainly meet the case. In the same way, the N.D. case may seem to be guarding against the impossible, but, in view of the light-loading, very large span, and small moment of inertia, the case is really applicable. It is to be hoped that these two cases and the attendant ones for tail planes and fuselage will be altered to an arbitrary load on the tail plane and elevator surfaces.

For the primary and intermediate types of glider the same factors are necessary, not so much for the stresses when in flight as for those imposed when launching, landing, and handling on the ground, especially for club use, where some of the hands will be inexperienced.

Clubs should be very careful to ascertain whether the gliders they buy have a Certificate of Airworthiness recognized by the British Gliding Association, because if not the gliders will not be of use for test or competition flights.

There is no unreasonable weight imposed by these factors. If a glider is designed so as to be strong enough

to be handled on the ground, it will be found that but few parts will have to be increased in strength to comply with these figures. It must be remembered that the object of a glider is to fly in a wind; consequently, the weight must be reasonably high to gain sufficient speed to make flight in a wind possible.

# CHAPTER IX

## METEOROLOGY AND THE CHOICE OF A GLIDING GROUND

THE whole art of gliding is as dependent on the conditions of the atmosphere as that of sailing. There is a great similarity between the two arts. The sail-plane and the glider are as helpless in a dead calm as is the sailing ship, but with this difference: that the glider is becalmed on the ground and not far out to sea. Also, a heavy gale may make it advisable to put into port. The ship has only a few ports, but the glider has the port always just below and easy of access.

When sailing, the skill of the pilot makes all the difference between a rapid and successful voyage and a dangerous run from port to port. With the sail-plane the skill of the pilot makes possible a long cross-country flight, as compared with uncertain soaring round about the club gliding ground.

It is obvious that the contour of the gliding ground, and in cross-country flights the contour of the country over which the flight is made, bears a fundamental relationship to, and is, in general, the cause of those upward components of the wind which make soaring flight possible.

At the commencement, the club training ground may be considered. Reference to Fig. 5 shows the contour of a gliding ground which, though not ideal, is as good as can be found in most districts. On such a ground, gliding is possible with winds from a little south of west to north-north-east. With the prevailing wind in the south-west, primary training may be given from the point marked *A*, from which flights of 5 to

10 seconds will give the first taste of gliding to the beginner.

The next stage with this wind will be taken from *B*, which should suffice for the 30 seconds required for an "A" Glider Pilot's Certificate, from which the transfer

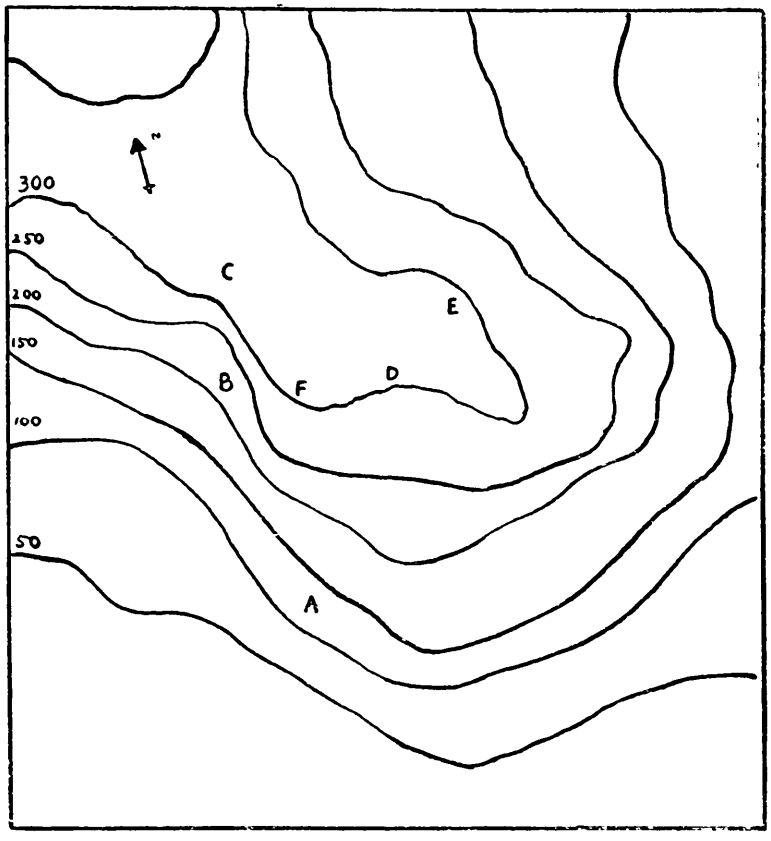



FIG. 5. CONTOUR MAP OF A GLIDING GROUND

to "C" will enable the 60 seconds' flight to be made. When the prevailing wind is blowing with a force of 25 m.p.h. it will be easy to soar when launched at the point "C."

There is little possibility of making any reasonable flights on a sail-plane unless the hills, which are not shown on the map, rise in a suitable form. With the wind from the south, satisfactory glides may be made from *D*, though there is little prospect of soaring on

an intermediate type of glider. The slopes from *E* are too gradual, but as the wind is generally fairly strong from the north-east, a considerable amount of instruction may be given on this side of the hill. It will be noticed that absolutely no instruction can be given when the wind is from the west to north-east. About 120 degrees of the compass is of no use.

## An Average Ground

This type of hill has been selected rather than a very good site, because it illustrates the type of hill that many clubs will have to be content with, and it illustrates one of the dangers of somewhat poor grounds. If the wind is in the north-west, it might be considered possible to launch from the point *F* in the direction of *B*. Such a practice cannot fail to result in a crash, serious or otherwise, according to the skill of the pilot and the steadiness of the wind. Owing to the shape of the hill, as indicated by the 250 ft. contour, there is almost certain to be an eddy about an almost vertical axis, somewhat similar to the eddies shown in Fig. 8, but, of course, in the other plane. This danger is one that can be avoided by careful exploration of the air currents in the manner already explained.

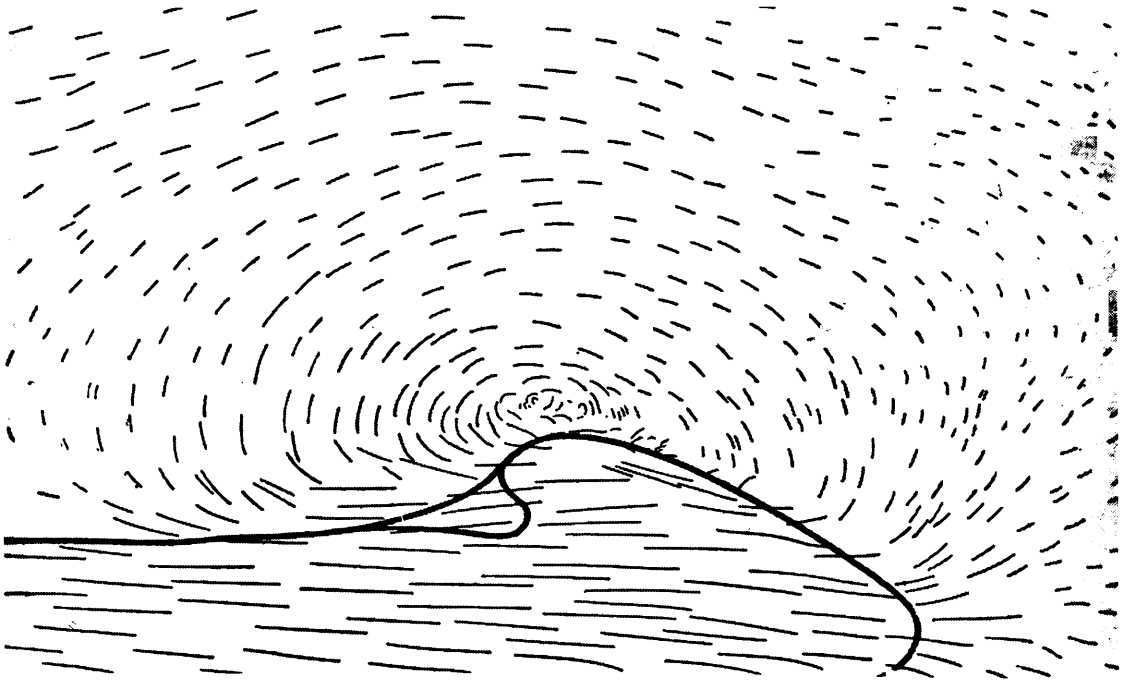
For sail-plane flights the gentle slopes for training are unnecessary, and hills with almost precipitous flanks are an advantage. Fig. 6 shows a piece of country suitable for a short cross-country flight. The start will not be made from the top of the first hill at *A*, because the slope of the hill is insufficient unless the wind is very high. The point *B* at the head of a small fold in the hillside will ensure a strong upward current of air when the wind, as indicated by the arrow, is blowing straight up the centre; hence the best point of departure is at *B*. The point *C* is also suitable, but, as *B* will give a

# PLATE XXIII

A Towed-flight in Darmstadt

The Tailless Aeroplane "Storch" as a Sailing Aircraft

# PLATE XXIV



MOVEMENT OF THE AIR ON THE ENTRANCE OF COLD MASSES OF AIR INTO WARMER MASSES, ACCORDING TO W. SCHMIDT

good start and there is a good line to follow along the hill to *C*, the best course is to start from *B*, soar along the hillside to *C*, and circle to gain altitude as is shown on the elevation at the bottom of Fig. 6.

Sufficient altitude must be gained at *C* to enable the pilot to glide down to a point over the next hill at *D*. Here the course of a small stream will ensure a good

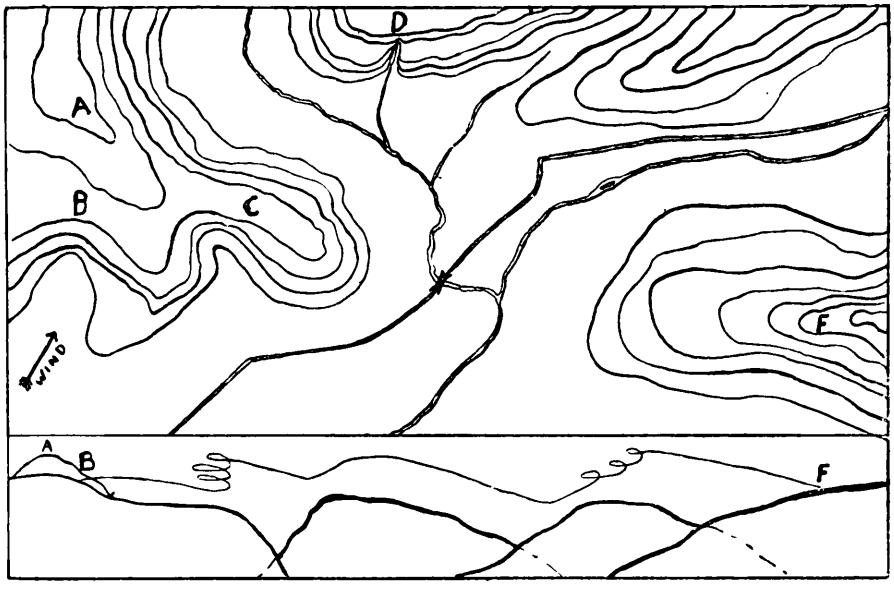



FIG. 6. CONTOUR MAP ILLUSTRATING CROSS-COUNTRY FLIGHT

up-current of air. As the whole of this hillside is very precipitous, sufficient altitude will be made to avoid the necessity of circling, and a glide may be made to the hill *E*, where considerable circling may be necessary, due to the more gentle slope of the hillside and the fact that it is slightly blanked by the hill *F*. When sufficient altitude has been attained, the pilot may glide to *F*, where he will either land, to return later, or by circling over this hill make sufficient height to commence his return journey, following much the same route.

This is the method followed in all cross-country flights, which are made by contour sailing. To illustrate

the principle in a small diagram the scale has been exaggerated, because for such an apparently short flight over such high hills it would be possible to dispense with circling more than once or twice. If the plan had been drawn to scale, the size would have been too small for easy reproduction.

## Mapping a Course

Before making a cross-country flight, the pilot studies his map of the district, using either the ½ in. layer contour map or the 1 in. with contour lines. The hill-

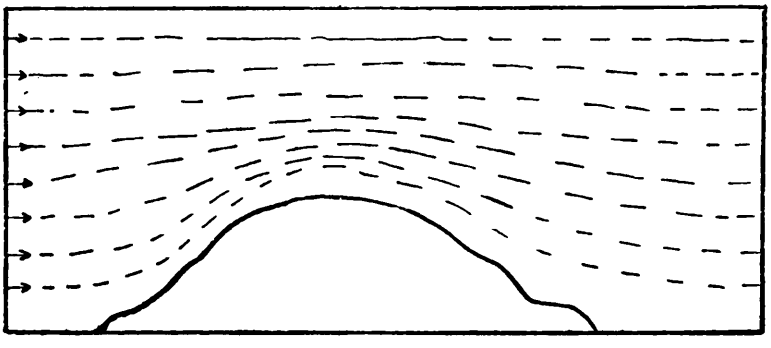


FIG. 7

shading map is unsuitable unless used in conjunction with one of the first mentioned. By careful study of the map the position of suitable up-currents may be determined and the course to be followed mapped out. All cross-country flights on motorless aircraft, with contour sailing, must be studied in advance in this manner.

Knowledge of the flow of air currents over hills is necessary before a course can be worked out with certainty. Reference to Figs. 7, 8, and 9, will help to illustrate this, but it must be remembered that eddies, as shown, are in a continuous state of flux and change. They diminish as the sun gets hotter, because the warm air rising from the valleys tends to blot out small eddies and decrease large ones; but these will reappear if the

sun is obscured by cloud for any length of time. All these factors require experience and skill, and they make sail-plane flying a sport second to none.

Fig. 7 shows the air currents over a rounded hill of moderate slope. Strong up-currents are present on the windward slope of the hill, with rather less strong down-currents on the leeward slope.

## Hidden Dangers

Fig. 8 shows the conditions on a hill with steep slopes. On the windward slope is seen the windward eddy.

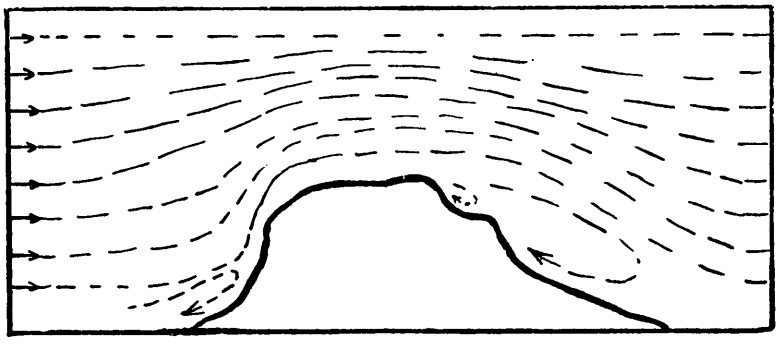


FIG. 8

The writer has seen an example of this danger. Soaring flight had been practised by several pilots. One, an experienced sail-plane pilot, soared apparently where he wished. Another was a pilot of great experience in power-driven aircraft but not used to soaring flight; he soared for some time, got into the neighbourhood of this eddy, observed the danger, turned, and landed in the valley. Another pilot, with some slight experience in soaring flight and moderate experience in power-driven aircraft, flew into this eddy without noticing it, with the result that he was slightly hurt and the glider was almost a write-off, a complete crash, which took ten days' hard work to repair.

On that day there was a strong, cold wind, and little

sun; on the previous day, when the sun had been strong and the wind somewhat warmer, although from the same quarter, the heat currents from the valley had completely masked this eddy and it had been safe to fly in this spot.

Cases have been known of attempted glides in the leeward eddy which produces an uphill wind, but the air was so turbulent that the machines were damaged.

## Eddies Caused by Hills

Fig. 9 shows the effect of several ranges of hills close together. Between two such ranges close together

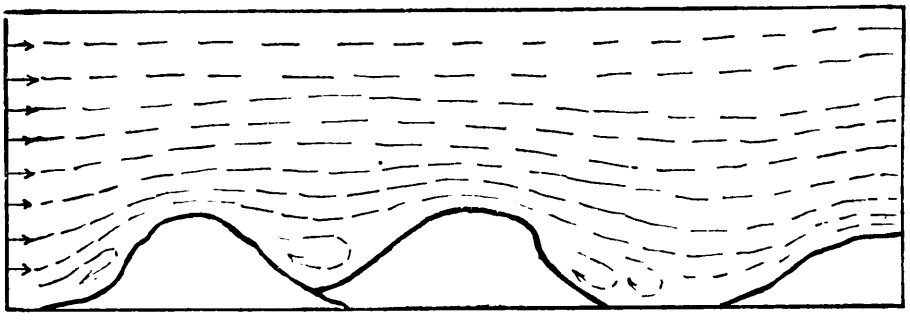


FIG. 9

there is a large eddy replacing the windward and leeward eddies, but where the hills are farther apart, the conditions more nearly resemble isolated hills. The distance apart of the hills to avoid the mutual interference will depend on the wind velocity and the temperature; the higher the wind and the lower the temperature, the greater the interference. These diagrams will indicate that in cross-country flying it is essential to keep up to a good altitude, and loss of height due to trying to glide too far will engender the risk of a forced landing.

It might be thought that cliffs by the sea would be useful for contour flying. All precipices and excessively

steep hills have dangerous eddies. Fig. 10 gives a diagrammatic representation of a cliff by the seashore. There are two dangerous eddies which are shown, these making it impossible to launch a glider off the edge of a cliff without risking a crash. At Scarborough in July, 1930, Herren Kronfeld and Magersuppe both

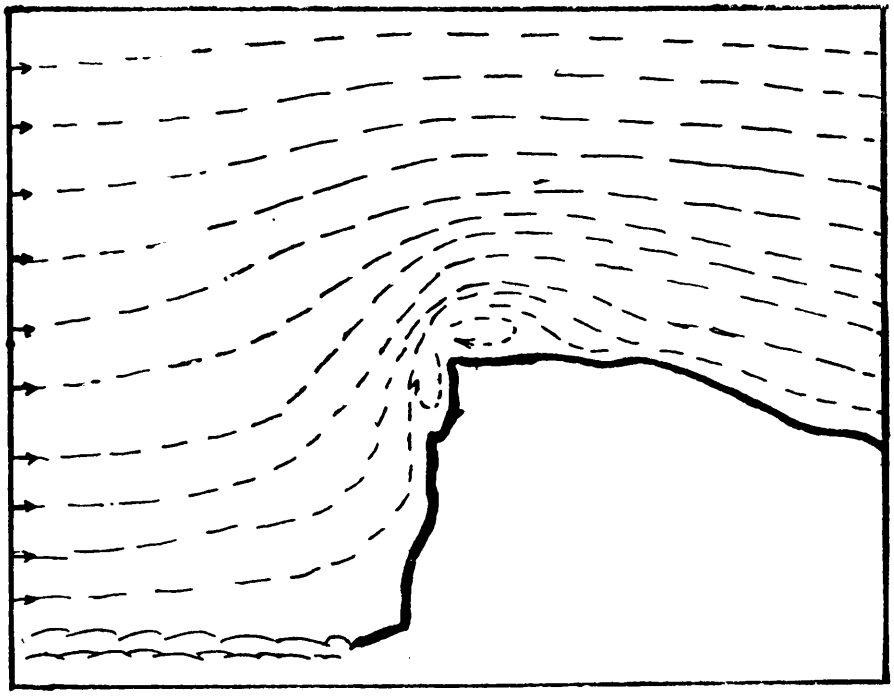


FIG. 10

crashed through making insufficient allowance for these eddies. The close proximity to any abrupt change in the slope of a hill is a source of danger to any sail-plane pilot who is gliding over it, unless he is at a considerable altitude above the eddies.

## Cloud Sailing

There is yet another method of cross-country flying —that of cloud sailing. This cannot be planned beforehand, because the clouds are always moving and changing.

Cumulus clouds are an indication of warm up-currents of air impinging on cooler air. The force of such up-currents may be estimated by the size and weight of hailstones. These are supported by these currents while forming and freezing before a change in temperature, due to the shade of the cloud, reduces the up-current and allows the hail to fall. Fig. 11 is a diagrammatic representation of such conditions, showing up-currents to the windward side of the cloud, and down-currents to the leeward. In fact, the up-currents

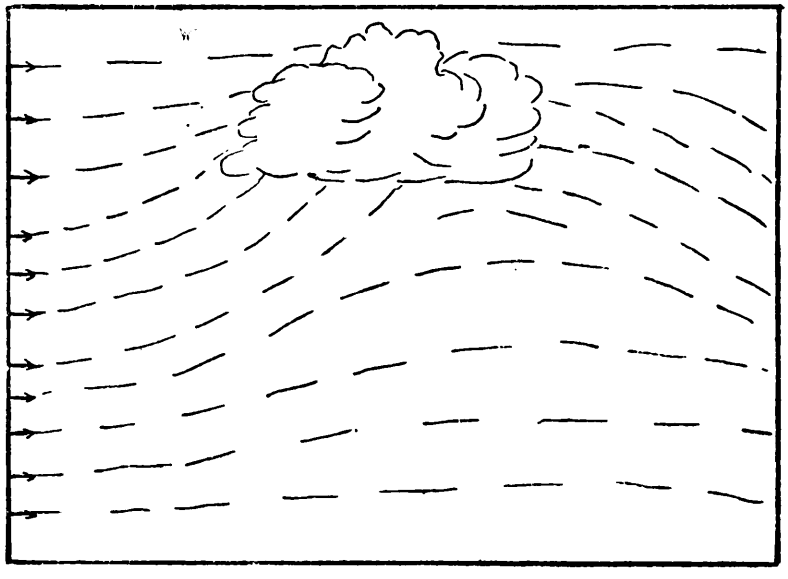


FIG. 11

are present right through the cloud, as may be seen in Fig. 23 in No. 1 of the *Journal of the British Gliding Association*, where an up-current of 10 metres per second is indicated. Such violent up-currents impose considerable stresses on the sail-plane, but if built up to the factors given on pages 75 and 76 the machine will be safe.

Fig. 12 indicates the manner by which a pilot, making use of the contours of the hill, circles up to get into the current which is supporting a cumulus cloud. With

this form of flying the pilot has to judge the time which will elapse before he can gain the advantage of an approaching cloud. If he misjudges the time he will only gain altitude in time to experience the leeward down-current, and thus lose his opportunity and have to look out for another cloud which may approach.

## Subject for Study

These rather brief notes on cross-country flight will only suffice to give some idea to the beginner. When he

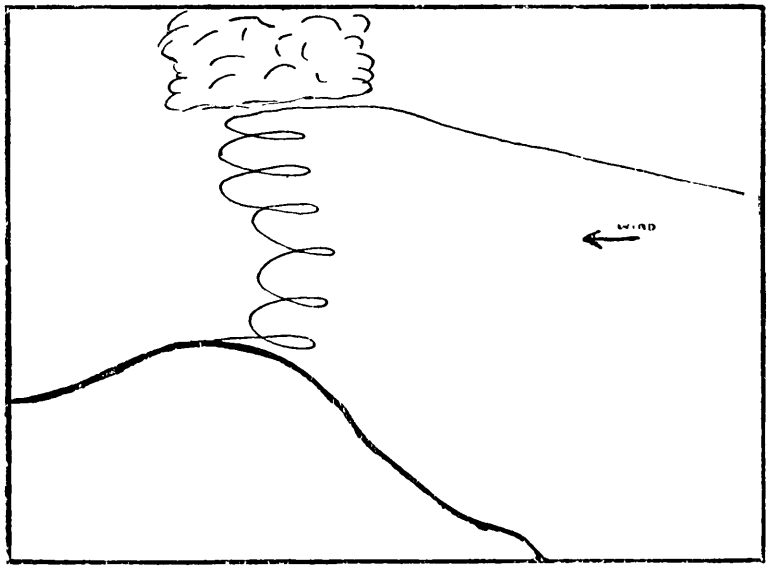



FIG. 12

is able to try cross-country flying himself, he will soon gain the necessary experience, and realize that it is a subject that will give him opportunity for study and pleasurable experience for many years.

The sail-plane is a very suitable kind of aircraft for forced landings, because, having no wheels, it soon comes to rest on alighting. It does not tend to overturn, and can be landed down wind in safety. Even alighting on water entails less risk of a crash than with normal aeroplanes.

It must not be supposed that such aircraft are easy to fly. They have the same controls as power-driven aircraft and are liable to the same tendency to stall and spin. But, owing to their lower stalling speed, light loading, and absence of wheeled undercarriage, the risk of injury to the pilot is considerably less.

# CHAPTER X

## CONSTRUCTION, REPAIRS, AND WORKSHOP ROUTINE

WHETHER the gliding club is one for advanced glider pilots only or for the instruction of novices, the workshop for repairs is of fundamental importance. The building must be of adequate dimensions, dry, well-ventilated, and heated. Gliders, especially the advanced types, are valuable and delicate pieces of apparatus. Consequently, if they are allowed to suffer from damp or improper handling, the club will lose money unnecessarily.

When a club has a record-breaking sail-plane which has won prizes in competitions, its value will be as much greater than ordinary sail-planes of somewhat similar type as is a Derby winner more valuable than a cab-horse. Each club should hope to have a "Derby winner in its hangars, and this will require overhaul and repairs, provision should be made to deal with such work.

The workshop should be not less than 30 ft. by 15 ft., which is the smallest shop in which repairs to a sail-plane like Herr Kronfeld's "Wien" could be repaired without risk of deterioration. A wooden shed built on brick foundation will suffice. The roof should be double to avoid excessive heat in summer. Some form of heating should be installed, which will not cause risk of fire and can be relied on to keep burning all night for repair work in winter. Good windows will be necessary, as well as provision for artificial light. Remember that a saving in capital cost may result in a great increase in fire insurance. Fire extinguishers are essential.

## The Equipment

The equipment of the workshop should include a bench 24 ft. by 6 in., with two carpenter's vices; this is for the repair of wings. There should be one bench 10 ft. by 4 ft., with two vices, and a small fixed bench with a fitter's vice under a window.

The small tools required include one rip saw, one hand saw, one tenon saw, one frame saw, one jack plane, one smoothing plane, one brace, a set of drills, three chisels, three gouges, two hammers, pincers, nail punches, "Fox wire benders," "Bernard" pliers, assorted files, medium and smooth, half-round, flat, and rat-tail, 8 in. and 6 in., a set of fixed spanners $\frac{1}{8}$ in. to $\frac{1}{2}$ in., one shifting spanner, four screwdrivers (assorted), a hand brace to take drills up to $\frac{1}{4}$ in., a set of twist drills $\frac{3}{64}$ in. to $\frac{1}{4}$ in., casine glue, brushes, varnish, dope, nails, etc.

Materials which should be kept in stock should include a sheet of $\frac{3}{64}$ in. plywood, aeroplane quality; silver spruce of suitable dimensions for spars (the dimensions will depend on the type of aircraft owned by the club); high tensile steel wire; spare wire strainers; ferrules; flexible cable for controls; fabric and tape; thread, needles, brads, screws, oil, etc.

## Replacements

Racks should be made to carry the tools with the outline of each tool painted on with the name, so that club members who use the workshop will know where to replace the tools when they have finished the job that they are doing. A list of tools and the date acquired should be hung up on the wall, and the list should be called over and the tools checked each week on a stated day. It will be found a good plan to make each member who works in the shop pay a small sum

into a fund from which all tools lost may be replaced. This replacement should be made directly the tool is missed, and a fresh levy made on the members who had used the workshop that week. Unless some such plan is adopted, the tools will become more and more scarce until the list is all that remains of the club equipment.

Any tools which may be wanted on the ground should be taken from a stock reserved for that purpose, because tools that have been dropped on wet grass and left there a few hours are useless for repair work, or for building new aircraft.

When a glider has been damaged, it should be returned to the hangar, carefully avoiding further damage by careless handling. It should be remembered that the glider will be more easily damaged when in a partly damaged condition than when all parts were strong and in their correct positions. The glider should be dismantled, all undamaged parts should be carefully stored, and the broken parts taken to the workshop.

It is almost certain that a wing will be damaged, in which case the fabric should be taken off and thrown away (unless the damage is purely confined to the wing tip, in which case it need only be turned back far enough to expose the broken ribs and one rib farther).

The broken parts may now be removed and the spars examined. If it is found that a spar shows any sign of weakness, it should be pulled out from the ribs after loosening the screws or brads which hold the ribs. A new spar may be cut to the old dimensions. Great care must be taken to see that the new spar is not smaller in any dimension, especially as in some gliders the spars are only just up to size. Before sliding the new spar into place, holes must be drilled for the wire plates and the end fittings. Take care that the holes are marked

off exactly, because, as the bolts for the main wire plates are at the point of greatest stress, there must be no additional weakness through bad drilling. Slide the spar in through the undamaged ribs and replace the wire and end plates.

It will probably be necessary to replace some ribs. Take an undamaged rib and draw the outline on the second-size bench. Screw small blocks of wood to hold all the component parts of the rib. Remove the sound rib and build up a new one exactly the same on the temporary jig which has been made on the bench. The rib must be left in the jig until the glue is set. Make up as many as required and complete the wing.

## Replacing a Wing

The wing must now be examined by the ground engineer or member who is responsible for repairs. When the wing has been passed as safe and in good order, again check it over to see that the turnbuckles are locked (see page 57) and proceed with the covering. Use new fabric and sew it on in exactly the same way as it was found before dismantling. When doing the first repair to any part, watch carefully how each part was fixed before removing it. Glider construction is not necessarily the same as for power-driven aircraft. When the fabric has been fixed on, the wing should be doped in accordance with the instructions issued by the makers.

If the skid is damaged, strip carefully, taking note of the construction, and examine to see if any of the framework of the body is strained or damaged. If it is, this must be repaired first. Build up the skid and body with new parts cut to the same dimensions as the broken ones, and after the glue is quite dry apply a coat of varnish or paint, according to the finish of

the glider. Remember that paint weighs surprisingly heavy.

If the club members are careful to observe how the parts are made and are careful that their workmanship is better than, rather than as good as, the original machine, repairs will not present many difficulties.

## A Winter Sport

When the glider is stripped for repairs it is a good plan to make drawings and jigs so that the club members can make a new glider or set of spare parts when the weather is too bad for gliding. Gliding is a winter as well as summer sport, but probably few members will wish to glide in the pouring rain.

For the more advanced types of gliders, only a few clubs will be able to do their own repairs. The workmanship which is absolutely necessary for sail-planes is quite beyond the facilities of a club, and in this section of maintenance the damage must be replaced with new or reconditioned spare parts. The storage of such spares must be carefully done. The workshop is large enough to act as stores. Ribs and spars for sail-planes' wings may be hung from the roof. Spare tail planes and rudders should be hung on the walls. Spare skids will be required. Spare rubber blocks should be wrapped up to protect them from light and air, which are the worst enemies of moulded rubber.

The chief point to bear in mind is that stores must be kept at an even temperature and dry, whether the club is actively working or closed on account of the weather. Those clubs which cease work for the winter months will be losing the best part of the year in this country, which has mild, open winters, with plenty of wind, but some readers will be forming clubs in parts of the world where either the winters are too

cold or the summers are too hot to enable the club to work.

In all club activities, remember that care for the *club property* and replacement of old or worn-out aircraft and tools is essential to success. A suitable first-aid outfit should be kept in the hangar.

## Design and Construction of Club Gliders

There was once a popular idea that gliders might be constructed from a few simple drawings by amateur workers for £5. It is fortunate that this fallacy is dying out. Twenty years ago gliders were made without drawings, of rough material, by indifferent workmen, but these gliders did not fly well enough to make the necessary flight to qualify for the "A" Glider Pilot's Certificate. Aerodynamic knowledge was almost entirely lacking. No one knew the right way to make any form of aircraft. There were no data for strength calculations, but, owing to the inefficiency of the gliders and their light weight, the inevitable crash did not hurt the pilot.

Of hundreds of gliders attempted, scarcely a dozen ever made any flight at all, and not more than six flew for 15 seconds. Of those which did make flights, the first three designer-pilots were killed. The pioneers who blazed the trail of aeronautics paid a very heavy toll of life, whether they started with gliders or power-driven aircraft.

## The Design of Gliders

It may be taken for granted that gliding enthusiasts do not wish to repeat this history, but would prefer to start from the point of comparative safety found at such cost by the pioneers of gliding. The amateur designer who does not understand the symbols $Kx$ and $Ky$, or the "Theorem of three moments," will be well-advised

to confine his enthusiasm to constructing gliders from drawings supplied by the British Gliding Association, and to have his work inspected for airworthiness. The label which is attached to the glider when it has passed all requirements is a certificate of which the amateur builder can be proud. It shows that the glider has been made up to real aircraft standard of workmanship.

For the designer who intends to master the science of aeronautics and make a real contribution to the design of motorless aircraft, there is a large field of research. A frank acknowledgment by the budding designer of his ignorance of the subject and a willingness to make a real study of it are essential to success.

The best procedure is to join the Royal Aeronautical Society as a student-member, borrow books from the library, and work at the subject of aerodynamics and structural design until a good knowledge of the design of aircraft has been obtained, after which the design of motorless aircraft becomes possible. It must be realized at the start that the problem of designing a sail-plane (the definition of a sail-plane being a glider with a sinking speed of less than ·8 metres per second) is harder than the design of an ordinary two-seater power-driven aeroplane with a 50 h.p. engine. In Germany the "advanced" clubs produce the new designs for sail-planes, and it is to be hoped that the same will apply in this country.

The time required to get out the design of a high-performance sail-plane may be about six months, or rather longer if the club members are not able to give more than about twenty hours a week, and supposing that eight or ten members are working. This is mentioned to show that the design work is longer and harder than the construction.

It is probable that in a few years' time any sail-plane which stands a chance in competitions must have a gliding angle of 1/30, or higher, and a speed range from 20 to 70 m.p.h. There is already a design under construction in Germany which shows higher figures than this on paper.

## The Glider in Relation to Power-driven Aircraft

The field of the gliding movement is almost entirely sporting and scientific. There is little prospect that it will have any commercial value except in India and some other tropical countries where meteorological conditions permit vultures and other heavy birds to soar all day long. In such countries it is probable that motorless aircraft may have a real commercial value.

As a training for aeroplane pilots it is ideal. A young sail-plane pilot who had never been in a power-driven aeroplane was recently given a test in a dual-control machine. Without any instruction he made perfect landings and get-offs, and after half an hour's instruction would have been able to go for the qualifying flights for the "A" Certificate. Gliding produces "hands," with the result that all flying is easy to the experienced sail-plane pilot.

There is a tendency in Germany to design aircraft by making models, gliders, and then the power-driven aeroplane, without the usual costly and rather uncertain wind tunnel experiments. The results so far obtained show a marked increase in the efficiency and speed of aeroplanes designed in this manner compared with the usual procedure. It is certain that this study of motorless flight will result in a greatly increased efficiency in all types of aircraft.

# CHAPTER XI

## GLIDING FOR WOMEN

THERE can be little doubt that the wave of gliding enthusiasm which is passing over the country is not merely an indication of temporary interest in a fascinating recreation. The mere fact that many long soaring flights have been made is an indication that not only is gliding a practical possibility for the individual of limited means, but also that there is promise of future achievement in this phase of air sport which will give it permanent popularity.

Gliding is still in its infancy, but sufficient has been accomplished to show that in the course of a few years pilots of motorless planes may have a control of their machines which at present is only dreamed of, and when soaring flights from point to point will be a commonplace experience even for those who have had comparatively little training. What the experts are doing to-day the ordinary club member of a few years' time will be doing quite easily. So much can be anticipated from the progress that has already been made in the perfection of soaring flight.

### Women and Aviation

It may be taken for granted, too, that women will find in gliding a new sphere of pleasure and achievement whose attractions they will not be able to resist. Indeed, they are already taking up gliding with enthusiasm—and it has been abundantly proved that when the young womanhood of our generation takes up anything with enthusiasm big things happen!

Many women pilots have already made enviable

reputations for their skill in aviation, and have proved that what man can do in the air they can do also. Outstanding achievements which must be placed to their credit include the 9,000 miles flight of the Duchess of Bedford from England to India, and then back to England; the wonderful flight of Miss Amy Johnson from England to Australia, which set the whole world talking of the daring and the skill of English womanhood; the exploits of Lady Bailey; and the winning of the King's Air Cup Race by Miss Winifred Brown.

## First Woman Pilot

Many women pilots are now showing a keen interest in gliding, amongst them Miss Amy Johnson herself, who has become the first President of the Scarborough Gliding Club, and reports from the gliding clubs that are now being formed so rapidly in all parts of the country show that women's keenness to enjoy the pleasures of gliding is just as great as that of the men.

Within a week or two of its formation, for instance, the Dorset Gliding Club had enrolled ten lady members, who were anxious to take the air in the club's gliders, and to this club must be given the distinction of providing the first woman glider pilot in Great Britain. This honour goes to Mrs. Norman Wright, the wife of the chairman of the club, who was quickly infected by her husband's gliding enthusiasm and was one of the first members to be instructed in the control of the club's first machine. Mrs. Wright, who knew absolutely nothing about flying or gliding before she became interested in the Dorset Club, envisages the time when at the end of a wedding report we shall read something like this: "After the reception the happy couple left for their honeymoon in their two-seater glider, in which they will make a tour of the British Isles."

## Vision of the Future

"Those who have not heard of the new sport of gliding," she says, "would be puzzled if they read this paragraph in an account of a wedding. But anyone who has seen a glider (which is purely and simply a motorless aeroplane) in flight, would be neither puzzled nor incredulous at the announcement, so great are the possibilities of the machine. When one realizes that to-day an expert pilot can remain in the air for hours and travel many miles, it is obvious that gliding, for all its thrills, is not only useful, but must inevitably lead to great developments in the aviation of the near future.

"Besides, two-seater gliders are already an accomplished fact. I can imagine many people feeling sure, though, that no woman would ever risk her neck in a glider. And yet, in my club alone, there are ten women members, most of whom have flown. Some of them fly better than the majority of the men. There is a tendency to over-estimate the dangers of gliding, which to my mind is vastly safer than motoring. Learners are subjected to very careful supervision and are never allowed to go high.

## First Lessons

" Take my own case. My first lessons were restricted to slides rather than glides, down a very gentle slope. In that way the simple controls are soon mastered, and one quickly becomes accustomed to being 'catapulted.' When at last one is allowed to go really up, self-confidence is firmly established, and one enjoys the incomparable thrill of sailing through the air in a machine responsive to the least command. Both the drumming of the wind past the wings and the tranquil motion of the glider are delightful. I can only describe the sensation

as an exultation which makes a few seconds seem like a happy half-hour.

"Yes, you will say, but no one can make definite point-to-point journeys in a glider. My reply is that definite journeys can be made, given the skill, as hundreds of people have seen for themselves. Herr Kronfeld, the world-famous Austrian glider pilot, soars from place to place in his golden-hued machine, coming down and going up as he wills. What this pioneer is doing now the world will think commonplace shortly.

## A Cheap Recreation

"To me it is amazing that gliding, or soaring flight, as technically it is termed, has not made quicker progress. Aeroplanes may never become cheap enough to make aviation thoroughly democratic. A glider, on the contrary, can be built for £20 and bought for a little over twice as much. With a chain of launching stations up and down the country (far fewer would be needed than one sees of petrol stations to-day) there is no reason why gliding would not become a popular means of locomotion, just as cycling is to-day. Look out for pillion girl gliders—in 1935!"

Even if one takes from such enthusiasm a certain discount of reality, there is a good deal left which is not far from the truth as far as the future of gliding for women is concerned.

## Appeal to Women

Gliding is, indeed, a sport or a recreation—call it what you will—which should make a special appeal to women. The initial difficulties of the instructional period are overcome just as easily by women as by men, and the type of girl who is attracted by gliding simply for its own sake generally proves an apt pupil.

Gliding calls for keen, natural perceptions and a sure sense of touch in the handling of the control stick, and most women of ordinary intelligence have these qualities well developed. Women have already proved conclusively that the acquisition of "air sense" comes naturally to them, and the special fittedness they have shown in this respect stands them in good stead in gliding.

## Thinking Ahead

Flight without the aid of an engine makes special demands upon the intelligence of the pilot. In fact, it is no exaggeration to say that the intelligence of the pilot has often to take the place of the engine. It is a fairly simple matter for the novice to remain aloft on the supporting impulse of a strong upward current. It is when he gets to the end of the current, as it were, that the test of skill and airmanship comes. Glider pilots have literally to think ahead. The eventuality has to be anticipated and the mind of the pilot must be made up considerably in front of the call for action. It is not so much a matter of instant decisions as of decisions before the instant.

In gliding, it is the quick-working mind which achieves the best results. The mind of the average modern girl gives her this useful qualification for gliding, and, in addition, she has other mental and temperamental qualities which are most valuable to her when she takes to the air.

For one thing, she has that unique additional sense of immediate futurity which is generally called intuition. Whilst some prosaic people might be inclined to scorn the existence of anything in the nature of a sixth sense, there is no doubt that strongly-developed intuition is a sign of quick perception, which in turn is a synonym for a ready appraisement of circumstances

and an instantaneous decision as to how they should be met. This combination is often called for in the air, certainly quite as often in gliding as in piloting a powered-plane. The super-sensitiveness of feminine faculties gives women an advantage in work of this kind.

## The Sporting Aspect

Gliding will attract women not only because of its own peculiar fascination as a recreation, but also because of its sporting aspect, which is likely to become more pronounced as time goes by and the technique of gliding is developed. There are few sports more attractive to those who have an adventurous element in their nature, and once gliding has become firmly established, as it bids fair to do very rapidly, it will rank with the more exclusive sports of to-day, such as ski-ing and toboganning, in the strength of its appeal.

That appeal, however, instead of being restricted to a rather limited class who have the means to enjoy these pleasures, will be made to all who care to avail themselves of the opportunities which it offers. It can safely be assumed that amongst those who respond will be a large proportion of young women anxious to claim their share of the excitements and the thrills of the new sport of the century.

# APPENDICES

## APPENDIX A

### Specimen Rules for a Gliding Club

THE GLIDING CLUB

THE objects of the Club are to provide facilities for its members to practise and study "Motorless Flight."

The Club shall be affiliated to the British Gliding Association.

The membership of the Club shall be composed of Flying Members, Associate Members, Life Members, and Honorary Members.

The Club shall be governed by a Council, assisted by committees.

The Council shall be composed of a President, Vice-Presidents, Chairman, Secretary, Treasurer, the Chairmen of the Committees, and Representatives of the Club on the Council of the British Gliding Association.

The President and Vice-Presidents shall be elected annually for one year by the Council, at their first meeting in the Club's financial year.

The Chairman, Treasurer, and Secretary shall be elected by secret ballot by the members of the Club annually for one year.

The committees shall be the Finance Committee, the Grounds Committee, the Flying Committee, and the Contests Committee. Each Committee shall be composed of not less than three or more than seven members, elected annually for one year by secret ballot at the end of the financial year of the Club.

Each Committee shall elect from among their number a Chairman for the year.

The representative of the Club on the Council of the British Gliding Association shall be elected in accordance with the Rules of the British Gliding Association.

The quorum for a committee shall be two, the committees shall meet not less frequently than twice a month during the time that they are engaged on the activities of the Club.

The quorum of the Council shall be five. The Council shall meet ten times a year or as frequently as it deems necessary.

The Finance Committee shall prepare a Budget, which shall

be presented to the Council. It shall control the expenditure of the Club to that budget; any departure from the budget must have the sanction of the Council. The Treasurer of the Club shall be Chairman of the Finance Committee.

The Grounds Committee shall be responsible for the upkeep of the buildings used by the Club, and the proper maintenance of the Gliding Ground, fences, gates, and enclosures.

The Flying Committee shall be responsible for the airworthy condition of the Club aircraft, for the purchase and/or construction of new aircraft, for the issue of Flying By-laws, for supervising all flying and instruction, for the ground engineer, instructor, and/or other salaried staff who maintain the Club aircraft.

The Contests Committee shall be responsible for all sporting events, and for organizing these events in accordance with the regulations of the British Gliding Association.

The committees shall draw up By-laws for the conduct of the Club, but such By-laws shall not become effective until ratified by the Council.

The Club shall own, rent, or hire, such property or apply the Club moneys in such manner as the Council shall deem necessary to promote the objects of the Club.

The entrance fees and subscriptions shall be of such amount as shall be decided by the members at the annual general meeting, or at an extraordinary meeting called at twenty-one days' notice for that purpose.

Any member who is more than one month in arrears in subscription shall be excluded from all Club benefits.

The Committees or the Council may co-opt a member to replace a retiring member; the member so co-opted shall retire at the same date as the member whose place he has filled; he shall be eligible for re-election.

All members shall receive the benefits and privileges of the Club in accordance with the By-laws drawn up by the Committees.

The election of any person as a member of the Club does not constitute any liability on the part of the Club to provide the benefits and privileges of the Club, provided that if any of the benefits or privileges are withheld from any member, that member shall be entitled to receive the return of a fair portion of the current year's subscription which he or she has paid.

The Council shall have the right to suspend any member from the benefits and privileges of the Club without stating the reason, provided the whole of the current year's subscription paid by the member be returned to him or her.

That all members shall be elected to the Club by the Council

in accordance with the conditions printed on the Application Form signed by the prospective member.

That these Rules may be altered at an Extraordinary General Meeting called for that purpose at twenty-one days' notice, all members being informed in writing of the proposed alterations.

That a meeting of members, termed the Annual General Meeting, be held in the last week of January in each year.

### Specimen Flying Regulations

The following rules are obligatory on all users of the Club Gliding Ground who do not hold a "C" Glider Pilot's Certificate—

1. A member of the Flying Committee shall be in charge of all flying, unless the Club has a salaried instructor to whom these duties may be delegated.

2. The person in charge for the day shall measure the force and direction of the wind, and by suitable means (such as a smoke rocket or pilot balloons) ascertain the position and magnitude of any eddies or dangerous air currents. A record of the day's observations to be entered in the log book.

3. The person in charge shall decide whether the meteorological conditions are suitable (*a*) for novices, (*b*) for Glider Pilots holding class "A" Certificates, (*c*) for those holding class "B" Certificates. All members shall conform to this decision or forfeit the Club privileges and benefits.

4. The person in charge shall obtain a certificate from the Ground Engineer: (*a*) That any repairs to the Club aircraft which may have been necessary have been carried out in a satisfactory manner. (*b*) That the machines have been examined to verify that all parts are in an airworthy condition, and that they show no signs of having been strained or worn. (*c*) That the aircraft have been correctly rigged. (*d*) That all wire strainers, nuts and bolts, pins, and hinges have been securely locked.

5. The person in charge shall decide the number in the launching team, and the starting point for each member who uses the Club aircraft.

6. A suitable log book shall be kept in which the records of all flights shall be made, together with a full record of the meteorological conditions.

Members who fly their own aircraft shall be bound by the above regulations, unless they hold "C" Glider Pilot's Certificates.

Members shall not question the ruling of the person in charge during the day's flying, all protests or comments being reserved for presentation at a Committee meeting.

# APPENDIX B

## Where to Learn to Glide

A LIST of British Gliding Clubs, with the names and addresses of their Honorary Secretaries—

Barnoldswick Gliding Club: W. Catlow, 49 Church Street, B'swick.
Barnsley Gliding Club: C. A. Brown, 20 Rowland Road, Barnsley.
Barrow-in-Furness Gliding Club: R. Cuthell, 31 Church Street, Barrow-in-Furness.
Bedford Gliding Club: Capt. Hendy, 5 Beresford Road, Bedford.
Bolton Gliding Club: N. S. Howarth, 3 Whittle Grove, Smithills, Bolton.
Bradford Gliding Club: S. Young, 17 Roslyn Place, Gt. Horton, Bradford.
Bridlington Gliding Club: A. Wilkinson, Crescent Court, The Esplanade, Bridlington.
Bristol Gliding Club: A. McLoughton, 14 Woodstock Road, Redland Green, Bristol.
Cardiff Gliding Club: T. E. Llewellyn, 59 Queen Street, Cardiff.
*Channel Gliding Club: D. J. Donalds, Queen's Hotel, Folkestone.
Coventry Gliding Club: F. Meadows, Llangstone, Job's Lane, Coventry.
Doncaster Gliding Club: T. Burdett, 88 Alfred Road, Askern, nr. Doncaster.
Dorset Gliding Club: H. Campbell-Johnson, 4 Derby Street, Weymouth.
Dover Sailplane Club: F. Brewer, 24 East Cliff, Dover.
*Driffield and District Gliding Club: R. G. Spencer, The School House, Gembling, Driffield, Yorks.
*Dumfries and District Gliding Club: W. H. Davenport, Thornlea, Rochell Park, Dumfries.
Dunlop Aero Section, Manufacturers' Section: F. W. Tingle, The Dunlop Rubber Co., Fort Dunlop, Birmingham.
Eastbourne Gliding Club: H. G. Leggett, 81 South St., Eastbourne.
East Grinstead Gliding Club: E. J. Smith, Oakdene, Sackville Lane, East Grinstead.
Elgin Gliding Club: A. R. Garden, 71 South Street, Elgin.
*Essex Gliding Club: W. R. Bannister, 20 Badlis Road, Walthamstow, Essex.
Exeter Gliding Club: W. Stephen, 5 Bank Street, Newton Abbot.
Halton Gliding Club: Capt. C. H. Latimer Needham, R.F.D., Halton, Bucks.
*Harrogate Gliding Club: E. Addyman, The White House, Starbeck, Harrogate.
Herts and Essex Gliding Club: C. I. Baker, 110 Dunawa Road, Bishops Stortford.
*Ilkley and District Gliding Club: P. R. Fawcett, The Red Lion Inn, South Stainley, nr. Harrogate.
*Imperial College of Science Gliding Club, The Imperial College Union: P. Adorjan, Prince Consort Road, South Kensington, S.W.7.

*Clubs marked "*" are affiliated to the British Gliding Association.*

Isle of Thanet Gliding Club: J. Huddlestone, 17 Chapel Place, Ramsgate.
*Kent Gliding Club: R. B. Haynes, 14 King Street, Maidstone, Kent.
Lancashire Gliding Club: B. A. G. Meads, Esq., Broomfield, Alderley Edge, Cheshire.
Leeds Gliding Club: A. Gomersall, 25 Blenheim Terrace, Leeds.
Leicestershire Gliding Club: A. McLaren, Turksy Café, Granby Street, Leicester.
*Lincoln Gliding Club: H. Searle, The Manor House, Cherry Willingham, Lincoln.
Littlehampton Gliding Club: H. W. Carter, The Laurels, 17 New Road, Littlehampton.
*London Gliding Club: J. R. Ashwell-Cook, 44*a* Dover Street, London, W.1.
Malton Aero Club: J. N. Gladish, Welburn, Yorks.
Malvern Gliding Club: P. J. Harris, 32 Leinster Gardens, W.2.
*Manchester Gliding Club: F. Paxton, A.M.I.Ac.S., Cyntra, Poplar Road, Didsbury, Manchester.
Matlock Gliding Club: J. W. Walker, Dean Hill Villas, Matlock.
Merthyr Tydfil Gliding Club: C. L. Wills, "Ingleside," The Walk, Merthyr Tydfil.
Midland Gliding Club: J. V. Rushton, 17 Victoria Street, Wolverhampton.
North Lindsay Gliding Club: G. T. Lloyd, 3 Wells Street, Scunthorpe.
Nottingham Gliding Club: L. Burbidge, Welbeck Hotel, Nottingham.
*Oxford and County Gliding Club: E. Walpole, Brasenose Farm, Cowley, Oxford.
Newcastle Mechanical Club: A. P. Miller, 27 Philiphaugh, Wallsend-on-Tyne.
North Cotswold Gliding Club: H. C. Wright, 45 Merstow Green, Evesham, Worcs.
*Portsmouth and Southsea Gliding Club: E. A. Finley Day, 9 King's Terrace, Southsea.
Rainford Gliding Club: E. Bussey, "Calderbrook," Rainford, Lancs.
Rugby Gliding Club: T. Lonsdale Baldwin, Cote Hill, Husband's Bosworth, nr. Rugby.
*Sailplane Club of T.M.A.C.: J. Welding, 404 King's Road, Chelsea, S.W.
*Scarborough Gliding Club: E. C. Tasker, Harcourt Chambers, St. Nicholas Cliff, Scarborough.
*Southdown Skysailing Club: A. York Bramble, 14 Brunswick Street East, Hove.
*South Essex Gliding Club: E. A. Sissons, 19 The Pavement, Chadwell Heath.
Suffolk and Eastern Counties Aeroplane Club, Ltd.: W. J. Offord, The Aerodrome, Hadleigh, Suffolk.
*Surrey Gliding Club: C. H. Taylor, 24 Woodbridge Hill Gardens, Guildford.
Whitehaven Gliding Club: A. Wilson, "Summerfield," 4 Kensington Road, Whitehaven.
Winchester Gliding Club: W. Russell, Fordington Road, Winchester.
Wolseley Gliding Club: E. H. Doughty, A.M.I.M.E., Wolseley Motors, Ltd., Drew Lane, Ward End, Birmingham.
*Worthing Gliding Club: D. Harrison, 24 Ripley Road, W. Worthing.

*Clubs marked "*" are affiliated to the British Gliding Association.*

# APPENDIX C

## Conditions of the Gliding Certificate

(*Fédération Aéronautique Internationale*)

ISSUED BY THE ROYAL AERO CLUB
3 CLIFFORD STREET, LONDON, W.1

### TESTS

**CERTIFICATE "A."**

The candidate must carry out a flight for a duration of 30 seconds followed by a normal landing.

**Note.**—Candidates must have made at least 12 glides before attempting to qualify for Certificate "A." This does not apply to—

(1) Candidates holding Air Ministry Licence "A" or "B."
(2) Officers and non-commissioned officers in the Royal Air Force who are qualified pilots.

**CERTIFICATE "B."**

The candidate must carry out a flight for a duration of one minute, with two curves in the form of an "S"; the landing at the end of this flight must be normal.

**Note.**—Before attempting Test "B," the candidate must have carried out two flights each of a duration of at least 45 seconds.

**CERTIFICATE "C."**

The candidate must carry out a flight of not less than five minutes at a height greater than that of the point of departure.

---

In each Test the candidate must be alone in the Glider.

Tests for Certificates "A," "B," and "C" must be carried out separately and consecutively.

Gliding Certificates will be issued to candidates as soon as they have qualified for Certificate "A."

Candidates after qualifying for each of the Certificates "B" and "C" must produce their Gliding Certificates to the Royal Aero Club for endorsement. The fee payable for each Certificate is 5s.

Applications for Gliding Certificates must be made on the Official Form provided for that purpose.

## GLIDING CERTIFICATES ISSUED BY THE ROYAL AERO CLUB

| | "A" | "B" | "C" |
|---|---|---|---|
| C. H. Lowe-Wylde | 30–3–30 | 8–6–30 | |
| C. H. Latimer-Needham | 30–3–30 | 18–5–30 | 7–6–30 |
| M. D. Manton | 24–5–30 | 7–6–30 | 7–6–30 |
| M. L. McCulloch | 24–5–30 | 13–6–30 | |
| G. M. Buxton | 24–5–30 | 26–7–30 | |
| F/O. E. Lucas Mole | 7–6–30 | | |
| C. A. Price | 21–6–30 | | |
| D. M. T. Morland | 30–7–30 | | |
| Col. The Master of Sempill | 7–6–30 | 7–6–30 | 14–6–30 |
| J. R. Ashwell-Cooke | 20–7–30 | | |
| A. Goodfellow | 26–7–30 | | |
| Miss D. J. Bradbrooke | 1–8–30 | | |
| T. G. Humby | 28–7–30 | 3–8–30 | |
| L. C. Williams | 31–7–30 | | |
| H. A. Abdallah | 1–8–30 | | |
| P. Michelson | 26–7–30 | | |
| F. B. Tomkins | 27–7–30 | | |
| E. C. S. Megaw | 1–8–30 | | |
| B. A. G. Meads | 27–7–30 | | |

# APPENDIX D

## THE "CELLON" CROSS-CHANNEL COMPETITION

(UNDER THE COMPETITION RULES OF THE ROYAL AERO CLUB)

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## Prize of One Thousand Pounds

### Offered by Messrs. CELLON LIMITED

---

The Prize will be awarded to the first British Pilot accomplishing a Motorless Flight in a Glider of all British construction from England to France (or vice versa) in accordance with the following conditions—

### SUPPLEMENTARY REGULATIONS

DATE.—The Competition will be open for a period of two years from 1st June, 1930, to 31st May, 1932, inclusive, unless previously won.

ORGANIZATION.—The Competition will be conducted by The British Gliding Association.

COMPETITORS.—The pilot of the glider must be a British Subject, and hold a current "C" Glider Pilot's Licence issued by The Royal Aero Club.

GLIDERS.—The Competition is open to any heavier than air machine, entirely constructed in the British Isles, not provided with any motive power, and which is not supported either wholly or in part by any gas which is lighter than air, and which has a current Certificate of Airworthiness issued by The British Gliding Association in accordance with its regulations at the time of the attempt.

OFFICIAL OBSERVERS.—The British Gliding Association will appoint Official Observers to control all starts.

ENTRIES.—The entry fee is £5. This fee, together with entry form, must be received by The British Gliding Association, 44A Dover Street, W.1, at least 14 clear days before any attempt is made.

STARTING PLACE.—The Competitor may select his own starting place subject to the right of veto by The British Gliding Association if such point is considered dangerous or otherwise unsuitable. The Competitor must obtain any necessary permission from the owner of the land as a starting place. All starts must be made during the hours of daylight. The Competitor is responsible for the Observer being notified beforehand of any attempts, and for his being present at the start.

LAUNCHING.—The launching shall be a normal hand launching by the usual methods, only hand traction being used, and not more than twelve persons pulling upon the tow rope or elastic.

TOWED GLIDING.—The glider shall not be towed in the attempt to cross the Channel. Any Competitor who is towed otherwise than when launching, in the manner laid down in the above regulation, is automatically disqualified.

THE FLIGHT.—The British Gliding Association will issue log sheets, which must be carried by the pilot in all flights in the Competition. The Observer will fill up the Starting Certificate on the log sheet and hand the same to the pilot prior to the start of any flight in the Competition. The pilot on landing must fill up the Landing Certificate on the log sheet. This certificate must contain such particulars as will enable the Association to locate the place of landing. The Landing Certificate must be signed as correct by the pilot and two responsible persons present at the time of landing, or, if none present, resident in the district where the landing was made. The landing must be made clear of the water.

SAFETY.—No attempt shall be commenced until The British Gliding Association shall have been satisfied that the pilot has taken all reasonable steps to ensure the safety of himself in the event of a descent on to the water during crossing.

The arrangements in connection with any attempt shall be made to the satisfaction of The British Gliding Association.

## GENERAL CONDITIONS

1. A Competitor, by entry, thereby agrees that he is bound by the Regulations herein contained or to be hereinafter issued in connection with this Competition.
2. The interpretation of these Regulations or of any hereafter issued shall rest entirely with The British Gliding Association.
3. The Competitor shall be responsible to the officials for the due observance of these Regulations, and shall be the person with whom the officials will deal in respect thereof, or of any other question arising out of this Competition.
4. A Competitor, by entering, waives any right of action against The British Gliding Association or Messrs. Cellon Ltd. for any damages sustained by him in consequence of any act on the part of the officials of The British Gliding Association, or on the part of their representatives or servants or any fellow competitor.
5. The machine shall at all times be at the risk in all respects of the Competitor, who shall be deemed by entry to agree to waive all claim for injury either to himself or his passenger, or his machine, or his employees or workmen, and to assume all liability for damage to third parties or their property, and to indemnify The British Gliding Association and Messrs. Cellon Ltd. in respect thereof.
6. The Committee of The British Gliding Association reserves to itself the right to add to, amend, or omit any of these Rules should it think fit.

*1st June*, 1930.

## THE ENTRY FORM IS AS FOLLOWS—

Name of Entrant (in full) .....

Address.....

### PARTICULARS RELATING TO THE ENTRY

Type .....

Overall Dimensions.....

Length .....

Height .....

Span .....

Constructor .....

Date of Constructing .....

Weight .....

Number of Certificate of Airworthiness .....

Name of Pilot .....

State what experience the pilot has had in flying or gliding.....

.....

Starting Place .....

The approximate date of first attempt.....

I have provided or am providing the following precautions for ensuring the safety of the pilot in the event of alighting on the water:.....

.....

I/We, undersigned,.....

of .....

British Subject(s), hereby enter for The "Cellon" Cross-Channel Gliding Competition upon the following conditions—

1. I/We agree to observe and abide by the Rules and Regulations for the time being in force and governing the Competition, and to comply in all respects and at all times with the requests and instructions regarding the Competition, which may be given to me/us by any of the officials of The British Gliding Association.
2. In addition to, and not by way of limitation of, liabilities assumed by me/us by this entry under the said Rules and Regulations, I/we agree also to indemnify The British Gliding Association, their representatives or servants, or any fellow competitor, and Messrs. Cellon Ltd., against all claims and damages arising out of, or carried by, any ascent, flight, or descent, made by me/us, whether or not such claims and demands shall arise directly out of my/our own actions or out of the acts, actions, or proceedings, or any persons assembling or assembled to witness or to be present at such ascents or descents.

Signature .....

Date .....

**A Map of the Proposed Starting Point and Course of Flight must accompany this form**

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