Sailplane and Glider

The First Journal devoted to Soaring and Gliding

JULY 1951

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Sailplane and Glider

Sailflying
Sailflyer
and ULTRA LIGHT AIRCRAFT

THE FIRST JOURNAL DEVOTED TO SOARING AND GLIDING

JULY 1951 ★ Vol XIX No 7

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COVER PHOTO:
The 'Prefect' at Detling. By D. Minterne.

Editorial

ONE of the benefits of a Free Press has been signally demonstrated even in the small gliding world of Great Britain and this magazine. Last year there was considerable dissatisfaction at the way that a choice of a team was made for the International Competitions in Sweden, and we did not mince our words in criticising the course then adopted. The result is seen in this year's National Competitions to be held at Great Hucklow, the site of the Derbyshire and Lancashire Gliding Club, between July 22nd-29th. The rules and the aim of this competition are to make the selection of next year's International Team automatic, in that the Champions of these competitions will be first choices for the International Team.

Having said that we feel ourselves entitled to give ourselves a pat on the back as we are firmly of opinion that had we not voiced our disapproval in such strong terms, matters might have been left as they were and our chances of doing well in International events have been nullified from the start. We believe that the present system will produce the right answers.

There is one other point which we feel to be of vital national importance and that is that although many competitors will be using non-British machines in this year's Contest, no Britisher should ever take part in an International Competition except in a British machine of which there are several first-class examples being flown at these competitions and of which there will be no shortage next year.

But we wish that more emphasis could be laid on getting more people into gliding than there are at present, or that present plans, with the aid of the Kemsley Flying Trust, allow for. It is true that there is nothing to stop a band of enthusiasts from starting their own gliding club anywhere in Great Britain to-day, providing they have a suitable site and a modicum of financial backing, but this is not enough. Twenty years ago when this magazine first began (we are twenty-one in two months' time), there were over a hundred gliding clubs in Great Britain. They fell away because of the high rate of crashery, due to inexpert instruction and a general lack of gliding "gen." However, matters are now so arranged in this country that there are literally hundreds of qualified instructors many of them in the R.A.F., R.A.F.V.R. and in the Royal Navy and the Army. In addition probably tens of thousands of people live in England to-day who understand the elements of gliding to a far higher degree than was the case twenty years ago. For example, since the war, over ten thousand "A" Gliding Certificates have been obtained, most of them through the A.T.C., whilst a number of Silver "C" Certificates is now over three-hundred, whereas, in 1939 it was about one-sixth of that number.

No doubt there will be many visitors to the National Contests this year who would like to take an active interest in gliding. Indeed at previous contests we have been approached by several aspirants to gliding skill. Starting and running a gliding club requires a great deal of enthusiasm, energy and spare time of which the latter commodity seems to be in short supply. Nevertheless, several gliding clubs have begun in Great Britain since the war but in most cases the lack of finance and the high cost of everything has impeded their progress. We are not in favour of a Government Subsidy, but we are in favour of a scheme which will link the nation's need for a large reservoir of experienced pilots to the undoubted assistance that gliding is to airmindedness and general airmanship. Only in numbers lies the key to cheapness and low priced aviation. We shall continue therefore to press for this matter to be considered at all levels until a satisfactory solution is achieved.

It has been suggested to us that more people would come into the movement were the money prizes offered to assume something of the order of thousands of pounds instead of something less than a hundred. In fact we know of one organisation which would be prepared to provide such prizes were the British Gliding world organised in some other fashion than at present. But this will reserve for later on. Nevertheless, the fact remains that gliding in Great Britain can only be indulged in, in comfort, by those who are comparatively rich, by members of the Armed Forces or the A.T.C., and by the poor only if they are prepared to endure most discomfort, arduous labour and in some cases financial stringency in other directions in order to provide for the high cost of gliding. We are no upholders of the Welfare State, which we think had a debilitating effect on personal morale and leads to decay, but we think that we could do more for ourselves to make gliding cheaper.

THE REAL START OF BRITISH GLIDING

By GEOFFREY DORMAN

(R.Ae.C. Press Steward of the 1922 Itford Hill Gliding Contest)

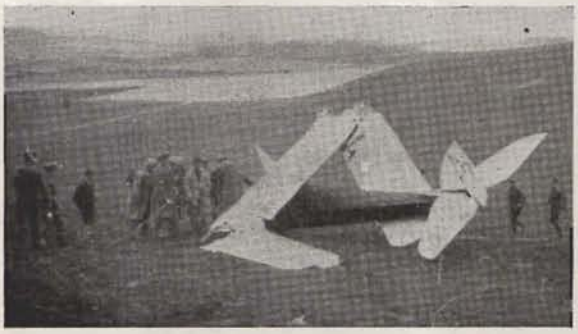
Georges Barbot on 'Dewoitine' making an emotional start at Itford Hill. He crashed, damaged glider, but was unhurt.

IN the Autumn of 1921 and the early part of 1922, reports were coming from Germany of extended flights of several miles, and duration flights of many minutes made with motorless aircraft.

In the terms of the Versailles Peace Treaty with Germany at the end of the war of 1914-18, Germany was forbidden to own, build, or fly power-driven aeroplanes, but was permitted to experiment with gliders for which no real use other than sport was visualised by the victorious Allies.

GERMANS' SUCCESS

Consequently the Germans took up gliding with the thoroughness for which they have always been noted. A gliding centre was established at the Wassekuppe, a mountain near Frankfort, and



After breaking up in the air. Herne standing in front and remarking, ' Now we shall go back to ailerons, I suppose.'

German youths took up gliding with a will and had much success.

If it had not been for the terms of the Treaty, it is doubtful if we would have the great sport of gliding and soaring as it is known today, and the sport of gliding may be said to have been sired by the Versailles Treaty out of Germany.

As the result of the successful German gliding, much interest was aroused in England, and many British visited Frankfort to see what was going on.

ENGLISH 'SPYING'

One of those who went was Squadron Leader Maurice Wright who was then a civilian test pilot to the Air Ministry. A news paragraph appeared in a London paper announcing his visit, saying he was of the British Air Ministry. The Germans were still smarting under the stigma of defeat, and resenting what they thought to be ' spying ', they cold-shouldered Wright and ceased all gliding while he was there.

Needless to say Maurice had only made the visit in his private capacity, being keenly interested in gliding as a sport, and the German suggestion of ' spying ' had no truth at all. He entered a glider which had been designed by himself, Frank Courtney the well known air line and test pilot, and W. H. (Bill) Sayers the Technical Editor of *The Aeroplane*.

Both Wright and Courtney made a number of downhill glides during the meeting, but did not have any soaring successes. Maurice Wright is now a director of the Fairey Aviation Co. Frank Courtney had a long successful career as a test pilot, both as a free lance and for Armstrong Whitworth and has been domiciled in the United States for more than twenty years. Sayers is with the tele-communications section of the Air Ministry.

FRENCHMAN'S PART

The winner of the Daily Mail prize of £1,000 for the longest duration flight during the week of the contest, from 16th to 21st October, 1922, was a Frenchman, A. Maneyrol, who flew a ' Peyret ' tandem monoplane which looked a freak, and which no one expected would fly. He had made no attempt to fly until the last day.

Only three months' notice had been given of the meeting and there were no gliders outside Germany, but in spite of that there were 36 entries, of which sixteen came to Itford Hill, and thirteen of them flew ; many of them were still being finished in the canvas tent-hangars at the foot of Itford Hill during the actual meeting, including Maneyrol's ' Peyret.'

When he brought it to Firle Beacon at the East end of the Itford Hill range on the last afternoon of the meeting, a very strong north east wind was blowing. No one paid much serious attention to Maneyrol when he was given a bungy launch.

We were amazed when this odd looking craft, with main and tail planes of the same span and chord, at once soared up on the wind to about 300 feet, and seemingly under perfect control moved lazily up and down over a bowl in the hillside from which there was a steady smooth current of ascending air.

His launch was made at about 3 p.m., when the longest soaring flight up to then had been one hour and fifty-three minutes by Freddy Raynham on his ' Handasyde,' who had seemed to us to be the certain winner.

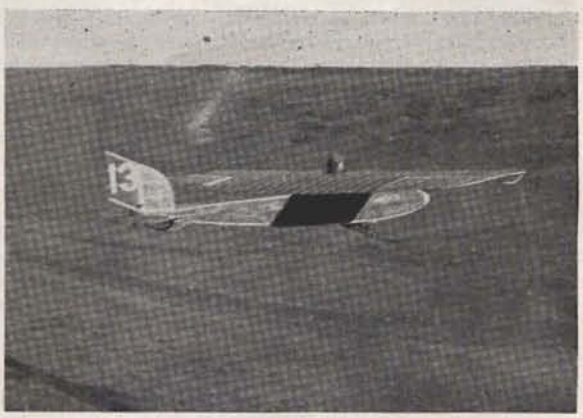
Maneyrol remained airborne until the close of the contest at sunset on this last day, by which time he had been up for three hours and twenty-one minutes. The light was fast fading when he landed on a smooth bit of ground on the top of Firle Beacon which had been illuminated for him by headlights of cars. He was given a great reception and taken off in triumph to a dinner given by the *Daily Mail* at the Esplanade Hotel in nearby Seaford.

CHAMPION KILLED

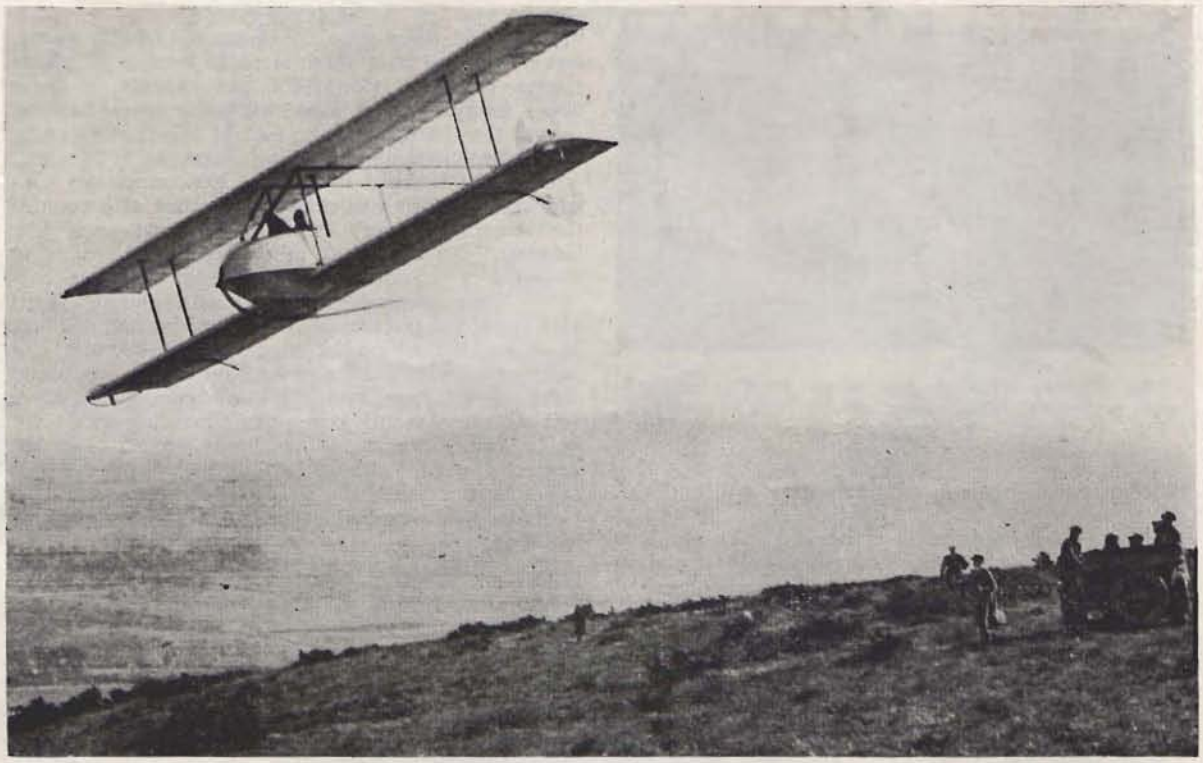
He was killed the following year at Lympne, when the wings of a ' Peyret ' normal monoplane ' motor glider ' with a 700 c.c. broke with a down load when he was approaching to land. He fell about 200 ft. and was killed instantly.

Soon after Maneyrol had been launched, a young R.A.F. officer, Squadron Leader Alec Gray, brought out a glider he had made from the top wing of a captured Fokker ' D VII ' fighter, and the fuselage of a ' Bristol ' fighter. He was launched from Firle Beacon, but fell back with a heavy thud and no one expected him to do much good.

He was launched again and soared up into the air



E. Gordon England in flight.



Tony Fokker making the first passenger glider flight in England at Itford Hill, Sussex, in October, 1922.

under full control, and it seemed he could have stayed up indefinitely. But he did not have his launch till more than an hour after Maneyrol, and when the time came when Gray could not beat Maneyrol even if he stayed up until sunset, he landed, as he was both hungry and thirsty. Now Alec Gray is an air-vice-marshal.

BRITTANIA TROPHY WINNERS

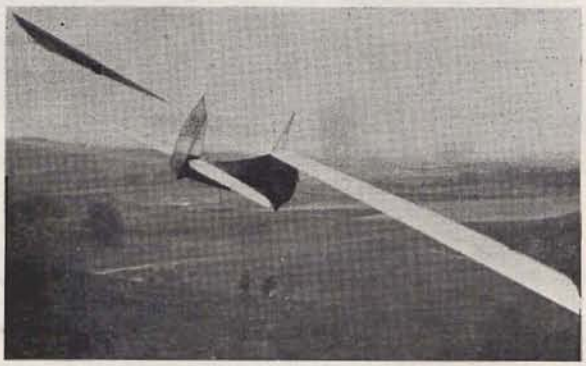
Of the other competing pilots, Freddy Raynham became a director of the Air Survey Co., and did much flying in India for that concern. He was made a squadron leader during the war ; I last heard from him in 1947, when he was living in Bexhill, when I invited him, on behalf of the R.Ae.C., as a previous winner of the Brittania Trophy, to a presentation of the Trophy.

He won the Trophy for his flight at Itford of 1 hr. 53 mins., the only time it has been won in a sailplane until Philip Wills won it in 1950.

The de Havilland Co., built two gliders, ' DH 52,' one flown by Hubert Broad, and the other by E. D. C. (' Buller ') Herne. Broad became a famous test pilot, first with de Havillands and then with Hawkers, and is now outside representative of Dowty's. E. D. C. Herne was an air line pilot with Daimler Airways, after which he joined Jack Savage's skywriting concern as a pilot.

Like most other gliders at Itford, it was found that the controls of the ' DH 52 ' were too small, as no allowance had been made for lack of propellor slipstream. It was decided to lock the ailerons of the ' DH ' gliders and obtain lateral control by the primitive wing warping. When Herne made the first trial with this modification, the wings began warping on their own as he was launched from a lower slope of Itford Hill, and they broke, dropping a rather angry ' Buller ' about 20 feet, who stepped out unhurt, gave a loud sniff, and said 'Now we'd better go back to ailerons.'

One entry was by someone who called himself J. J. O'Freddy who entered a sail biplane which had ' power provided by the pilot paddling.' He never



Herne's ' D.H. ' beginning to break up in the air after having had the wings converted from aileron control to warp

appeared, but a wire was received from him during the week to say he was arriving by air under his own power from Sheerness. Presumably he was a practical joker.

FIRST SOARING FLIGHT

Eric Gordon England entered a monoplane which he made, on which he did the first soaring flight of the meeting. He crashed and broke an ankle. Later he became the first chairman of the B.G.A. and until quite recently was a director of a ladies' hair waving concern.

F. W. Merriam, one of the pioneer ' Bristol ' pilot-instructors, flew a glider he had built. He stalled on top of a bungy launch and hit the ground in an incipient spin, but was shaken but not much hurt.

Anthony Fokker brought two biplane gliders, one of which he flew himself, and the other was flown by Gordon Olley who is today the moving spirit of Olley Airways Ltd. Tony Fokker died about twelve years ago in the United States.

Georges Barbot flew a ' Dewoitine ' without very much success, and Rex Stocken flew a monoplane built by the Aircraft Disposals Co. Ltd., on which he won a prize for the longest glide in a straight line from launch to landing, less than a mile. Rex to-day is an aviation consultant, is British representative of Interavia, and is managing director of Airco Ltd., which moves in a mysterious way its wonders to perform. He was a Wing Commander during the war.

E. Gordon England immediately after take-off

There were a few freak machines which caused a lot of merriment but did not perform, one of which was an ornithopter, and one a sort of would-be flying bicycle. A ' monoplane helicopter ' was entered by two men named Purton who called themselves the British Helicopter Co., but they did not arrive at Itford.

Lt.-Col. J. T. C. Moore-Brabazon, M.C., M.P., who is now Lord Brabazon of Tara, was the judge, and Harold Perrin was secretary of the meeting. The week provided much good clean fun, and was the first of the ' get togethers ' where everyone of the British aeronautical community foregathered with their wives, fiancees, or best girls and had a pleasant sociable evening, drinking, dining, dancing and nattering, and all got to know one another well, which was a VERY GOOD THING.

TO BREAK STRANGLEHOLD

'ONE of the main assignments at the 18th National Soaring Contest, Harris Hill, July 4-12, will be to break the stranglehold of the Russians and Germans on international records,' says Paul Schweitzer, Contest Committee Chairman and General Manager of Schweizer Aircraft Corp.

' Germans and Russians hold six of the ten major single-place and two-place records,' continues Schweizer, ' and the United States holds only three.'

Only since World War II have American soaring pilots provided serious competition to the Russian and German pilots. In 1947, 22-year old Paul MacCready broke the international distance-and-return record with a 220 mile soaring flight.

Again last year veteran soaring pilot ' Bill ' Ivans flying a new streamlined all-metal Schweizer ' 1-23 ' sailplane soared to over 42,000 feet, or 30,000 feet above point of release, to break the existing international altitude record by about 9,000 feet.

GOVERNMENT AIDED

Most of the records set by the Germans are hold-overs from before World War II, when the German government subsidized soaring as a training aid to the formation of its air force. The records held by the Russians, including the coveted distance mark of over 465 miles for a single-place ship, were all accomplished with the aid of government funds.

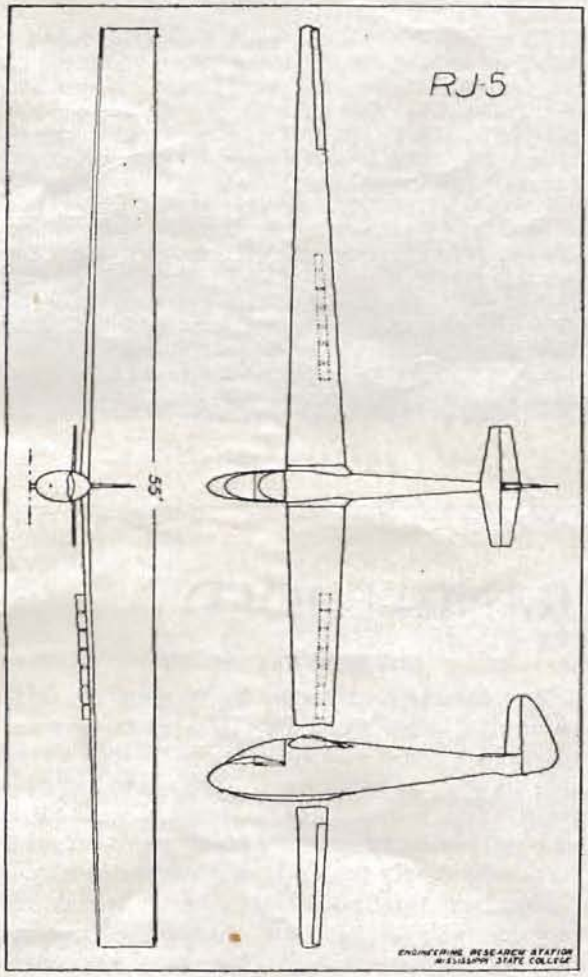
Soaring in the United States, though it was put to good use by the Air Force in troop carrier operations during World War II, has never been subsidized in any form during peacetime. Despite this handicap, U.S. soaring pilots have shown tremendous improvement in postwar years.

Last year, Paul MacCready, only U.S. entry in Sweden's International Soaring Contest, placed second after leading the field of almost 100 crack European soaring experts. Once again this year's Elmira's National Contest will be graced by the presence of feminine sailplane pilots.

THE DEVELOPMENT OF THE

By RICHARD

IT was in May of 1948 when Harland Ross and I decided that the American skies needed a new sailplane. There never had been one in North America which could report a 30-1 glide ratio excepting perhaps the then new French ' Air-100.'



At the onset the design was almost entirely that of Ross. We agreed on the general layout and I commissioned him to do the construction. I might mention that the new laminar airfoil was brought to our attention by Dick Lyon, a Hughes Aircraft engineer, and we are eternally indebted to him for the fine choice. Also Stan Hall and some of his associates at Northrop undertook the tedious stress analysis and spanwise lift distribution calculations.

' TINY MITE ' TEST FLOWN

Work was soon under way at Bishop, California, and in the meantime I decided to join Dr. Raspet at Mississippi State College and assist him with the sailplane project of the Engineering Research Station while attending the Engineering School there. At his suggestion I brought my ailing sailplane ' Tiny Mite ' to flight test. It was from these tests that we gained a great deal of information that was going to help us with ' RJ-5 ' and also gave me a deep appreciation for accurate flight testing and analysis for which Dr. Raspet is well known.

Harland worked hard but found the construction of the metal wings was more difficult than he had expected. By the winter of '49-50 he had the spars and leading edges completed, a start on the flaps and aileron, and the monocoque fuselage shell well along. He had spent 2,200 hours on the construction. It was then that we agreed that I should undertake to complete the craft at Mississippi State College. This made us happy at Mississippi State as it gave us a chance to modify the design to agree with what we had found to be good practice.

First of all the wing location was raised from its intended midwing position to a high wing. We had found this to be very essential to obtain high wing efficiency and low drag, especially at high lift co-efficients. If an appreciable amount of fuselage extends above the wing then the boundary layer attached to this part of the fuselage will cause a discouraging amount of airstream separation which means drag and poor spanwise lift distribution.

MODIFICATIONS

Next the wing angle of incidence was reduced so that the axis of the fuselage would be the same as that of the airstream at 80 m.p.h. This meant poorer take-off and landing characteristics, though not objectionable, and perhaps some loss in L/D max. It does give better glide ratios at high speeds which we felt was essential for the type of machine I wanted. The incidence of the wing with the fuselage axis is $+2.5°$ measured from the zero lift chord. After flying the ship in the summer competition, I feel that we did the right thing as my most efficient cruising speed (calculated) was rarely under 90 m.p.h. Hence the operation almost never included the speeds between thermal flying, 45-50 m.p.h., and that of cruise.

A landing wheel has a fine place on a trainer but most certainly not on a performance job. Therefore a landing skid was used and a dolly made to facilitate ground handling. Bruce Cormichael, engineer at Goodyear Aircraft, calculated that the drag of a wheel was about equal to a flap plate of twice the area of the wheel projection. This is said to be due to the effects of the airflow in and around the wheel well.

'ROSS-JOHNSON 5' SAILPLANE

JOHNSON

Probably the biggest control problem of sailplanes is that of adverse yaw and we set about to see if we could make some progress here. Small conventional ailerons with only 6 square feet of area apiece were designed and spoilers just inboard of them were made to start opening when the aileron was deflected up 12°. The aileron differential is two to one, giving a maximum up travel of 30° and 15° down. Thus the spoilerons would be full open when the aileron was deflected up 30° and of course closed on the other wing.

'RJ-5' as last flown. Notice integrating wake rake at trailing edge of right wing, sealed spoileron.

This system worked well in flight and the machine had a surprisingly decent rate of roll. During the summer competition I found that I could fly all day and almost never deflect the ailerons far enough to open the spoilers (12°).

In the following fall accurate flight tests were made to find what needed improving. Even after we changed the canopy design, the ship still had a poor efficiency factor of 62%. Looking for trouble we tried larger fuselage-to-wing fillets but obtained no success there. Next the spoilerons were removed as they provided a small amount of airflow between the bottom and top of the wing even when retracted. The results were most gratifying, the efficiency factor rose to 70%, the L/D max. increased 1.2 points, and the minimum sink decreased .1 ft./sec. On top of all this the lateral control was still as good.

FLIGHT EVALUATION TEST

On flight evaluation tests we measured the time in seconds to roll a machine from a bank to 45° to an opposite 45° bank, using full control and an airspeed of 20% above the stalling speed in level flight. With spoilerons the 'RJ-5' rolled in 6.2 seconds and without the spoilerons in 6.2 seconds also. This fine result with such abnormally small ailerons touched off a series of other tests on the 'TG-3' and 'Pratt-Read.' It was found that both these machines would roll faster with only the outboard half of the aileron operating than with the whole aileron. Also the control forces and adverse yaw were reduced about 50%. In all cases the aileron controls were deflected to the stops, the control systems have a negligible amount of elasticity, and the wings are quite stiff torsionally. More research in this matter is being undertaken here to determine the reason why this occurs.

I had originally planned to use the highly effective D.F.S. type dive brake for glide and speed control, but after giving some more thought to the problem, I decided differently. A spoiler on the top surface of a wing is undesirable for several reasons. First of all, unless it is a smoother installation than any I have seen, the roughness has its share of drag but most of all this roughness will trigger separation of the airflow at high lift co-efficients. Also any air leakage from the inside of the wing past these spoilers add a rather fair amount of drag. The biggest objection is that these spoilers, while causing the desired drag (when open), they actually decrease the maximum lift available from the wing and hence

induce a higher stalling speed. Most aircraft designers realized years ago that on a landing approach both high drag and high lift is desirable. Sailplanes should be no exception, therefore a simple split flap was installed on the bottom surface and hinged at the .50 chord span. Data showed that this type of flap located in the rear position of the wing causes a negative pitching moment (about the lateral axis) but if located in the forward portion the pitching moment will be positive (up). For use as dive brakes no pitching moment is desired which dictated the intermediate location used. The extra lift derived from the flap is greater when located aft but the pitching moments made this compromise tolerable. Because of their lifting effect, I find them helpful in take-off also. A seven foot flap span on each wing was necessary to hold the terminal dive velocity to 130 m.p.h.

THE MACHINE ASSEMBLED

Now that we have the thing put together, let's look at her. The wing is somewhat unusual with its 24.5 aspect ratio and slight sweep forward. The area is 123.5 square feet, the span 55 feet. The two wings join at the centre line of the fuselage and are held there by eight half inch bolts in tension passing through machined dural fittings. There are two main dural (spars) located at 20% and 50% chord and the 24 ST skin covers them and the leading edge, so as to form a two cell torque structure. The dihedral is 2.5°. In addition to the described dive flaps on the bottom there is a plain trailing edge lift flap, thought at the time to be desirable for thermal performance. They cover 40 feet of the wing span leaving 14 feet for ailerons and 1 foot for the tips. This flap, and the aileron also, are piano hinged at the top surface and have an undesirable slot open on the bottom side. This is admittedly crude and only later did we find how much drag it caused.

The airfoil is the NACA 63_2-615 laminar which has a favourable pressure gradient (approximate laminar region when smooth) from the leading edge back to .35 chord. The airfoil design lift co-efficient is .6 and the laminar bucket extends about .2 on either side, depending somewhat on Reynolds number.

The wing thickness is 15% from root to tip, that is the wing tapers in plan form only. The taper ratio is high being 3.5. The washout was carefully measured and is only 1.5 degrees. Despite the high taper ratio and small twist, the stall characteristics are much better than anticipated, being perhaps better than a ' T.G.-4A,' but of course not as gentle as training craft such as the ' Weihe ' or ' Olympia.' The maximum co-efficient of lift of the wing is now 1.34—better than many.

The fuselage is a standard wood monocoque structure using mahogany plywood skin and spruce structure. The cross-sections are elliptical for the most part. The original canopy, used in the '50 competition, was blown plexiglas and was approximately a 90° section of a sphere. It was smooth but because of the high negative pressure co-efficient over it, due to the small radius, the canopy caused the air to separate over the wing and fuselage at lower speeds. By replacing it with a long radius canopy that extended to the nose cap we were able to gain another 2.0 points on L/D max. and reduce the sinking speed by .2 ft./sec.

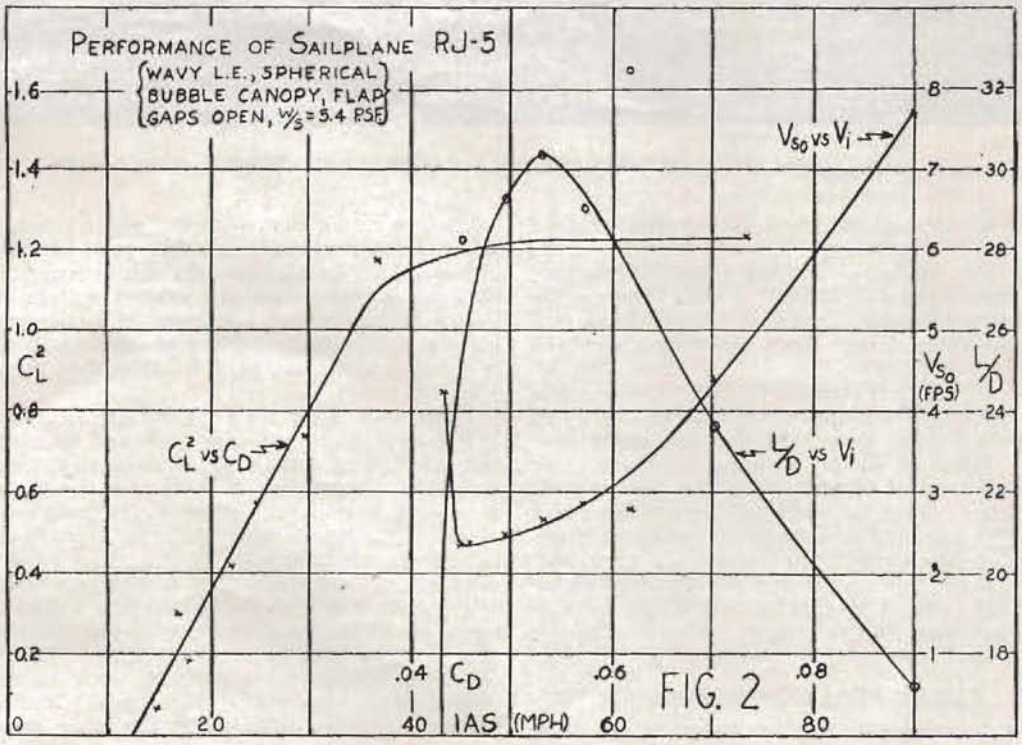
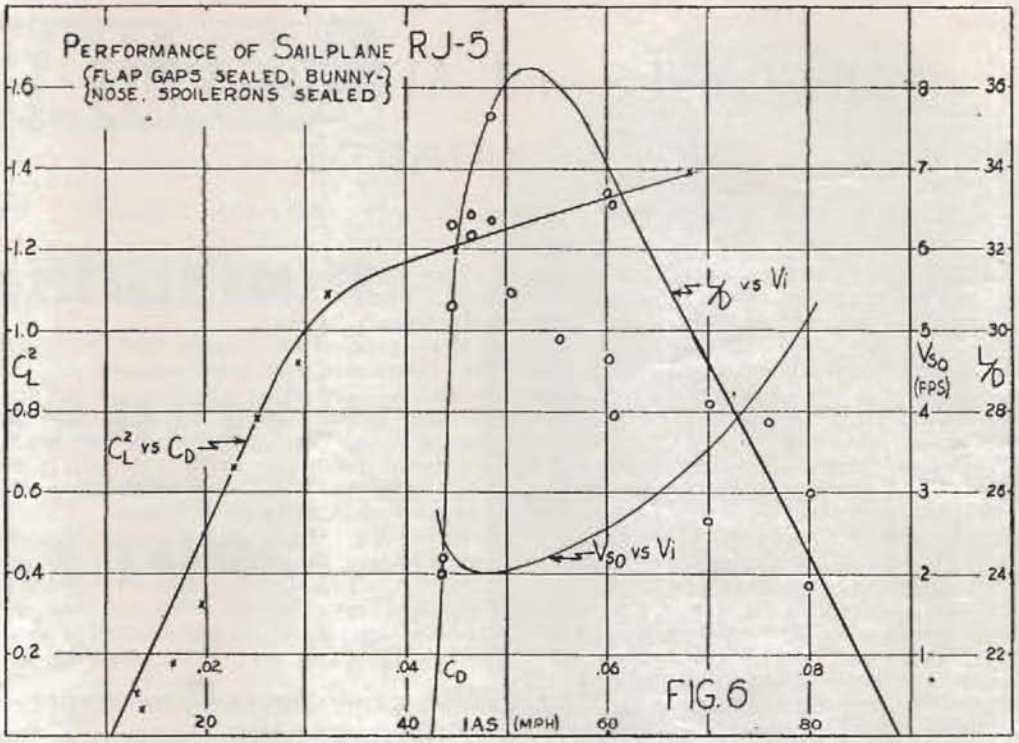


FIG. 2



CANVAS LANDING SKID

A pitot head recess is built into the balsa nose block as are the two static nostrils. The landing skid is a common canvas sided affair causing perhaps more drag than a ship of this type should tolerate. Next winter I intend to install a skid that will manually retract flush into the fuselage. No performance predictions yet, but we will measure the increment of drag on future flight tests.

The empenage is built of spruce, plywood and fabric. It is rather ordinary with the exception of having somewhat better aspect ratio, on both the horizontal and vertical surfaces, than most other sailplanes. A high aspect ratio vertical and horizontal tail surface is highly desirable from an aerodynamic standpoint, for stability, control and drag reduction.

Of all the control surfaces only the elevator is 100% staticly balanced and it was done in an unusual manner to save weight and drag. The complete static balance unit weighs two pounds and is located in the fuselage under the wing. It consists of a 90° bellcrank, one end of which is connected to the elevator cable and the other to a 15 inch length of tubing weighted on the far end. This gives the ship very nice longitudinal stability and control. Releasing the elevator control at any airspeed the ship stably returns to 50 m.p.h. and stays there.

The empty weight of the complete ship, ready to fly, is 492 lb., when last weighed. Of course the wings are the major part of this as they weigh about 190 lb. per panel. The wing loading is 5.4 pounds ft.^{2}.

FANTASTIC GLIDE RATIO

To fly the 'RJ-5' is an experience to be appreciated. With the canopy sealed it is so quiet that one can hear the steady purr of the tug's engine while on tow. The glide ratio seems fantastic and I am still amazed at how far it will go. When passing over the landing spot with 250 feet of altitude and 70 m.p.h., I can make a pattern taking me one mile out and still return to the landing spot. I have done this, to my endless delight, on many mornings after completing a dawn performance run.

The wings are quite stiff torsionally and flex only a little laterally in flight. One difficulty not yet solved is that of the ship being not stable enough in yaw. On performance calibration runs, I have to give a good bit of attention to the wool tuft yaw indicator and constantly work the rudder, or the performance results will be very poor. Dr. Raspet believes this yawing might be due to the airflow changing from laminar to turbulent and back assymetrically along the wing thereby giving varying drag and yawing moments.

After looking over the flight test data we both decided the wings needed improving the most. The contour was smooth over the first 50% (fabric aft of that) but divergance as large as .2 of an inch from the true contour were measured. Also I felt that the additional weight and drag of the trailing edge flap far more overshadowed their effectiveness in thermal flight. Even with the flaps slots taped over, our wake rake measurements of the wing profile drag indicated .0088 instead of the .0056 obtained by NACA at a Reynolds Number of 3 million.

This past winter found me (*Continued page* 164)

SAILPLANES and AEROPLANES

By B. S. SHENSTONE

Chief Engineer, British European Airways, M.A. (Sc.), A.F.I.Ae.S., F.R.Ae.S.

SAILPLANES have influenced aircraft design for many years. Sometimes the influence has been obvious, sometimes indirect and sometimes even unconscious.

Powered aircraft design is so much of a compromise and so much money is involved that bright ideas must be applied sparingly and development is sometimes rather slow.

The sailplane or glider enables bright ideas to be applied quickly and cheaply, so they attract brighter and brighter designers, who feel rather frustrated in the big firms. But there is no money in it, so it is work done on the side in spare time.

The great difficulty is in getting the designs built, for even a sailplane costs some money. First real hope was raised when the Ministry of Supply offered to assist the building of Kendall's two-seater. This was, from the Ministry's side, through the efforts of Stewart Scott-Hall, one of the founders of the B.G.A. and therefore a gliding enthusiast for over twenty years.

EXPERIMENTS ON GLIDERS

Both aerodynamic and structural ideas can be tried out on gliders and there are some fine examples to quote. The high aspect-ratio wing was first developed from sailplanes. With it was developed the D-nose structure and with it were experienced aileron reversal and wing and aileron flutter. The sailplane designer was the first to build really clean aircraft with properly fair and smooth surfaces. His difficulty was, for years, how to prove that the smoothness was worth-while. Nowadays, the use of snap-head rivets on modern aircraft would be sneered at, but in 1931 the Schneider Trophy seaplanes at 400 m.p.h. were covered with them.

In the early 1930's the only cantilever wings of high aspect ratio on aeroplanes were on Messerschmitt transports, and had grown from sailplanes. Nowadays we often see large aircraft with aspect ratios of 12.

The use of gliders for experimental purposes is well-known. G. T. R. Hill's efforts on tailless aircraft were started with gliders, and his later collaboration with the Canadian National Research Council resulted in the interesting all-wing type on which lengthy stability and control researches were made.

There are, of course, the well-known experiments by Alexander Lippisch which led to the first rocket fighter, the ' Me. 163,' and finally to the super-swept Delta configuration which so many designers have adopted. Again, there was Kupper's work on the prone pilot which was done on gliders, and the Russian work on large sweep-forward which may or may not have been used on new jet aircraft.

Now the glider has made the new generation of light aircraft possible. I refer to the new ' Mauboussin ' types.

Many people have thought that the ' Spitfire ' or the ' Hurricane ' were based on glider design or work on gliders. The writer who was connected with one of these fighter designs can state with assurance that as far as the ' Spitfire ' was concerned, it was not based on glider work, although it used the single wing spar and D-nose construction which was first used successfully on sailplanes.

As for the ' Hurricane ', although the writer has not discussed the matter with its chief designer, it may be safe to say that it is essentially the old-time ' Hawker Fury ' fuselage, with only one wing, and that the designer would feel insulted if gliders were brought into it in any fashion whatever.

CAN SAILPLANES CONTRIBUTE?

All this has happened, but has everything happened? Is there anything left that the sailplane can pass on to powered aircraft? Of course, we cannot say definitely very much about it, but I can see no reason to assume that if for thirty years the glider has contributed, it should stop now. Of course, it does depend on who is interested.

There are some of us who are quite happy to put pen to paper and design things that are never built, but many more would do it eagerly and for no monetary reward if somehow the design could be built. It is very good for one's soul to see one's own first design take physical shape. It is shattering to one's conceit to see how dull some of the best paper ideas seem when committed in three dimensions, and how gross are one's weaknesses and carelessness.

It is very quick learning. After a few such efforts, one acquires (or some do) the feel for design and there is no need to look back. But until the designs are built, there can be no real contribution to aircraft design. There must then be ways of doing it. They may be :

1. The utter enthusiast who will, with his own bare hands, build a prototype with his own and his friends' money. There are not enough of these to go round.
2. Wise assistance from the Ministry of Supply which I hope will continue for worth-while designs by designers with real ideas.
3. Equally wise help from special funds such as the Kemsley Trust.
4. Efforts by schools or universities which have an interest in design. It is, as indicated above, essential to build designs, not just draw them and, although the cost may seem high, the end-product of a man who has seen his thought

or his colleague's thoughts grow from a line to a liner, as it were, can be of the best.

THE GREATEST DIFFICULTY

Perhaps the greatest difficulty to be contended with is that of soundness of design. If an unsound design is built by any of these four methods, it will end in disappointment and waning interest. How do you discover whether a design is sound, remembering that we want to encourage bright ideas and hence discourage repetitions of well-tried schemes?

There is no use having a board consisting of well-known aircraft designers, because they could hardly ever agree and would tend toward conservatism. Too young a group might not inspire confidence. The difficulties involved are seen by the experience in 1947 of the B.G.A. Design Competition judges, and of the earlier 1938 Olympic Sailplane Design Competition. Probably the best compromise would be a committee of four, an established designer, a bright 'coming' man, a research man in aerodynamics or structures, and a chairman with no axe to grind, but with good judgment. I purposely omit a pilot, although any of the committee might also be a pilot.

DESIGN COULD FLOURISH

If some such schemes could be set in motion and sailplanes built and flown, design would flourish. Some might border on the fantastic, but better a silly aircraft than none at all. I do not consider production here, but only prototypes. 'One off' is enough to prove a design and the most exciting thing that could happen to gliding in the U.K. would be to have the country littered with prototype sailplanes. The reaction on design as a whole would be immediate and good, for the young men would achieve confidence and a sense of form and fitness.

Just what does experience in sailplane design give to a man? I think it gives him a certain refinement because it is not too difficult and is aesthetically satisfying. It teaches economy because the problem is straightforward, without the vast number of secondary requirements that plague modern powered aircraft. The sailplane designer is necessarily an all-rounder and that may be what is wanted most of all, and hardest to develop nowadays.

It does not matter what material is used, nor is it disadvantageous that sailplanes are slow. As long as the designs are outside of present knowledge, even if mere extrapolations, they can be worth it. The problem of the very thin stiff wing, unusual tail surfaces, comic landing gears, quick demountability, pressure cabins and many other things can be played with ad lib. on gliders, and applied directly or indirectly to the more serious aeronautical problems of transportation and annihilation.

A RANGE of light-weight accumulators is being made by Venner Accumulators Ltd. These are based on the silver-zinc reaction and have been in production by Venner's for about three years.

They are about one half the size of conventional accumulators and about one third of their weight. The electrodes are encased in a semi-permeable membrane which acts as both dielectric and separator, the complete assemblies being fitted into an injection-moulded case under slight pressure. The electrodes cannot buckle, neither can the active material escape from the membraneous wrapping and fall to the bottom of the cell and cause short-circuiting.

In addition, as the electrochemical reaction is completely reversible and stable, the shelf-life of the accumulator is remarkably long. At the same time, the ultimate life of the accumulator is not impaired by its being left in a discharged condition.

The greater part of the electrolyte is absorbed in the electrode assemblies and although the normal level for this is within ¼ in. of the top of the electrodes, accumulators can also be supplied and used with practically no free electrolyte. In this state they are quite unspillable.

During the normal charge-discharge cycle, very little gassing takes place. In common with other types of alkaline accumulator, very heavy rates of charge and discharge may be applied without detrimental effect. Charging is carried out in the usual manner, but maximum efficiency will, of course, be obtained when a charge system providing a tapering current is used.

The nominal voltage of all cells during discharge at the rated current is 1.5.V., a freshly charged cell showing a voltage level of approximately 1.8.V. The capacities available range from 0.5 to 40 amp. hr. at 1, 5, 3, 6 and 12v. Their ampere-hour efficiency is well over 90 per cent.

AIRSHIP AWAITS MAIDEN FLIGHT

Cardington, Bedfordshire: A view of the 'Bournemouth' the first British airship to be built since 1930. Under construction here, the 'Bournemouth' was inflated on May 24th. Responsible for this venture are Lord Ventry, of the Airship Club, and other enthusiasts, who can be seen discussing final details with an assistant.

SOARING IN FRANCE

REMARKABLE MAY

By GUY BORGÉ

MAY has been a remarkable month in France with a world record broken at Le Bourget du Lac, near Chambery.

On May 5, in a two-seater 'Kranich,' with Adjudant-Chef Lamblin as passenger, Captain Fonteilles covered 113 km. (70 miles) in 1 hour 43 minutes, at the average speed of 66 km./hour (41 m.p.h.)

The old record was held by the U.S.A. with 45 km./hour (28 m.p.h.) in a two-seater 'Briegleb' by the designer of the machine.

Captain Fonteilles had chosen an interesting circuit with 3 control points in proximity of the favourable slopes surrounding Le Bourget du Lac. The first point was situated at Gruffy, near the Semnoz chain; the second one at Gerbaix, near La Dent du Chat mountain, and the last at La Scia, near La Grande Chartreuse.

The 'Kranich' released in aero-tow at 1,300 metres (4,200 ft.), climbed to 2,900 metres (9,500 ft.) in a cloud; but because the pitot head had become iced, Captain Fonteilles opened the brakes, descended to 2,000 metres (6,500 ft.) and then attained 2,600 metres again (8,500 ft.) before taking his official start. He recorded the following times and average speeds:

Part of the circuit.	*Time*	*Distance*	*Average speed.*
Gruffy-Gerbaix	32 min.	31 km. (19 miles)	58 kmh. (36 m.p.h.)
Gerbaix-La Scia	41 min.	29.5 km. (18 miles)	72 kmh. (44 m.p.h.)
La Scia-Gruffy	30 min.	53 km. (33 miles)	106 kmh. (66 m.p.h.)

The average speed along the last part, the longest, is very fast. The ' Kranich ' is not however a swift machine, but we are certain that the present record of the single-seaters, held by the Swiss pilot Maurer, at Samedan, in a ' Moswey 3 ' at the speed of about 70 km./hour (43 m.p.h.) could be broken by Captain Fonteilles, for instance in the new ' Arsenal 4111.'

An exclusive article on this new French sailplane appeared in last month's Sailplane.

During the remainder of May the weather appeared very bad in the South and South East of France. Continuous rains, cold winds, low ceilings prevented any noticeable performance in this part of country. But elsewhere there were several favourable days with thermal activity and numerous interesting performances were made in distance.

WOMEN'S RECORD BROKEN

On the 11th May, Mrs. Choisnet-Gohard broke the French Feminine distance record. She started at 12.25 hrs. from Beynes in an ' Air 100 ' sailplane, and landed 5 hours 35 later at Rochefort, covering a distance of 380 km. (235 miles).

On the following days (May 12-13-14) a regional competition was held at Beynes and several women pilots showed their excellent soaring qualities.

Saturday 12th ; 9 pilots exceeded 300 km. (186 miles), of which six were goal flights : Miss Fruitier, Miss Leroy, Miss Delécolle, M. Marbleu, M. Breuil, M. Messier.

The best distance was 340 km. (211 miles) a goal flight by M. Braunswick. Weather was not however extremely good, with some rare cumulus, a veil of cirrus and a strong wind of North-East 40 kn./hour (25 m.p.h.). Four other pilots attained 180 km. (112 miles) in goal flights.

On Sunday, the pilots who had landed far away had not returned to Beynes, but a few lucky competitors were authorized to try distance flights, and two pilots flew to Saint Yan (325 km. or 201 miles).

Monday was very bad with low ceilings, many showers. But Miss Fruitier attained Chateauroux, 200 km. far (124 miles), and Miss Leroy 130 km. (80 miles) remaining three hours in the clouds.

During the 3 days of competitions, the pilots recorded a total of 10,000 km. and 400 hours of soaring, a nice total indeed.

Here is some further information about the *Beynes Regional Competitions* :

Number of Competitors, 29.

Sailplanes available :

9 ' Weihes.'
5 Nord 2000 ' Olympia.'
4 ' Air 100.'
1 ' Bréguet 900.'
1 ' Castel 311 P.'
5 ' Castel 310 P.'
1 ' Grunau.'
1 ' Caudron C 811.'
2 ' Emouchets.'

FINAL CLASSIFICATION

Performance Class.

1st. Miss Fruitier (' Weihe '),
2nd. Marbleu (' Air 100 ').
3rd. Massier (' Air 100 ').
4th. Breuil (' Weihe ').
5th. Miss Leroy (' Weihe ').
6th. Braunswick (' Air 100 ').
7th. Blanchet (' Nord 2000 ').
8th. Cayla (' Bréuget 900 ').
9th. Miss Delécolle (' Weihe ').
10th. Rousseau (' Weihe ').

Training Class.

1st. Puech (' Castel 310 ').
2nd. Salaün (' Castel 311 ').
3rd. Vaysse (' Grunau ').
4th. Charpentier (' Emouchet ').

THE DEVELOPMENT OF THE 'TRIGLAV'

by R. A. G. Stuart, M.A. (Cantab.)

THE ' Triglav,' a high-performance Jugoslav sailplane designed by Koser & Hrovat, first flew at Lescamo on October 12, 1948. After consultation with Borisek, Breznik and other leading pilots at the 2nd Aviation Meeting of the Aeronautical Union of Jugoslavia at Ruma, the designers decided to modify the design.

MODIFICATIONS

Among the modifications decided were :

1. Decrease of rudder movement and increase of pedal force necessary to move it.
2. Increase of stick force necessary to move the elevators.
3. Modification of the cockpit hood to eliminate tail vibrations caused by turbulent airflow from it.
4. Increase of the effect of the spoilers : although the designers thought that spoilers were perhaps unnecessary, it was found that most pilots preferred, them.
5. Alteration of the amount of pedal movement which was found in practice to be excessive.
6. To enable the pilot to land at high angles of attack without danger of hitting the ground tail-first.

In the original design the cabin became far too hot in the sun, so it was completely redesigned. This in turn involved a redesign of the fuselage.

There were also several minor modifications due

to shortage of materials at the ' Letov ' factory which was building a series of 10 machines of this type. Work on the ' Triglav II,' as the new version was called, began in August, 1949.

The designers wanted the new prototype to be built straight away but owing to the pressing need of the gliding schools for gliders this was not possible, and the new version was delayed.

Chief differences between the original ' Triglav ' prototype and the production ' Triglav II ' are :

1. Smaller rudder with smaller balancing surface.
2. Wooden fairing under the tail instead of the tail-skid on the original version.
3. The rear part of the fuselage slopes upwards at a larger angle and is not so deep, thus reducing weight at the tail, improving the CG location and permitting landing at a higher angle of attack.
4. The fore part of the fuselage is slimmer.
5. The shape of the removable plexiglass hood has been modified so as to permit moulding it in one piece.
6. The wing fillets have been discarded as they were continually breaking.
7. Dihedral was increased on the basis of experience with the ' Jadran ' seaplane glider.
8. Spoilers of the NACA 2b type were fitted.
9. A simple pedal-adjustment mechanism was fitted.
10. The instrument board was enlarged to take a Sperry Gyro-Horizon.
11. Assembly of the elevators is semi-automatic.
12. The elevator trimmer is differential to elevator movement.

RASPET'S HELP

Designs were completed on February 20, 1950, and proved entirely satisfactory. However, as a result of conversations at Orebro with Dr. Raspet, an American scientist of Jugoslav descent, it was decided to modify the type once more, resulting in the ' Triglav III.'

Main modifications suggested by Dr. Raspet were the reduction of induced drag by means of streamlined bodies of laminar profile mounted at the wing-tips, the installation of the Pitot tube in the nose, the fitting of a butterfly tail, the alteration of the trimming system and the fitting of a bubble type one-piece cockpit hood.

The butterfly tail was not fitted for the first tests but has probably been fitted by now. The ' Triglav III,' registered ' YU-4022 ' is undergoing extensive trials from which much useful information will be gained.

It will be interesting to see how it compares with its predecessors and with other types in the same class.

SOUTHERN BIRD GOES NORTH

By H. R. LASCH

(*Concluded from JUNE Issue*)

Gold 'C' and Diamond

Friday, July 7th. Order for the day : Speed Flight. To Lidkoping about 140 k.m.'s away was, in my conception, quite a little goal flight, but being asked to get there in a hurry made me feel most nervous because I had never flown on time before and apart from the normal nervousness one has before taking off on a sailplane flight, one had the additional peculiar tension one experiences before starting a ski race, a golf match or any other competitive sport.

The weather was fine and I was launched shortly after 11 o'clock together with most pilots and once I had released from tow and was circling upwards, I found that I was being joined by Billy Nielson and Pelle Persson ; I couldn't have been in better company. All three of us set off, once we had sufficient height, towards a cloud street in the direction of our goal and having reached it I spiralled up and went into cloud as my idea was to get well into it, set course and fly with as little circling as possible towards my goal. This I succeeded in doing and I had a most happy trip to Lidkoping where I arrived without any worries whatsoever. On arrival I found Billy and Pelle already there and in discussing the flight with them they figured that cloud flying certainly does not pay in order to get high speed, because while in cloud you must continually correct course to fly in a straight line and every movement of your rudder naturally acts as a brake and, therefore, your average speed goes down. It was a most valuable lesson and I was most fortunate to have such good people from whom to learn.

The next day was put down as a day of rest and this was most essential as you could notice fatigue in most competitors, especially the older ones, of whom I was one. I think it is a very wise move of a Committee to call for rest days, as this prevents accidents caused through fatigue, and I am not sure who are the most tired after some days flying, the crew or the pilot.

Sunday, July 9th. Order for the day : Speed Race to Norrkoping. The weather on this day was not as good as it had been and although Norrkoping is only 90 k.m.'s away, many of us had doubts whether we could get there. I was launched and while circling up I discovered Paul McCready releasing under me. This, of course, was a great

stroke of luck because I don't know of any man who can fly a sailplane faster than Paul and so I made up my mind to watch him like a hawk and follow him. I had not reached cloud base, which I intended to do, when I saw Paul, perhaps 500 ft. below me, set course for Norrkoping and he was off like a flash with me on his tail. It was wonderful to watch him fly, not exactly in a straight line, but weaving from side to side, pulling up whenever the air carried a little better and on his way again when things were normal. He did not bother to circle in any weak stuff and occasionally he just did one turn in the thermal and went on his way, putting his nose down to go through the down area, the way you start a loop. As soon as the down area was left behind he pulled back again to his precalculated cruising speed, I presume based on his famous circular slide rule. This game went on for about forty minutes when I lost sight of him, but I was now half way to Norrkoping with enough height to go there in a straight glide, and this I decided to do. I flew over some pretty bad country encountering a lot of red air and it didn't take long for me to sit some 250 metres up over some really well grown Swedish pines. The position was extremely awkward as there were no fields nearby and I remembered Colonel Hugusson's words ' If you have not picked your spot to land at 300 metres, the competitions will be over for you.' Floundering about over these trees I eventually found a spot where the variometer showed a few inches rise. I could not afford to go on and look for anything better so I began to circle most carefully in this extremely small vertical breeze. I was lucky that a little lake was nearby just within gliding range and I had made up my mind that if I lost any more height I would go into it rather than land in the trees and, if possible, enjoy a swim. I actually gained as much as 100 metres in what seemed an eternity, but having got there I found that drift exceeded gain of height and so I went back to the patch in the forest which generated this lift. On arriving at the spot I found that I had gained a nett total height of about 10 metres and I repeated this procedure again and again until after forty minutes I had gained some 200 metres, which enabled me to sail out of the forest over a little field. I was happy to have got this far, as it meant I would not lose my ship and I had given up all ideas of ever getting to Norrkoping. Arriving over the field I found some new lift and this was a different proposition because after ten minutes I had 1,500 metres, enough height to get me to my goal, for which I set course. The irony of it all was that from here onwards to Norrkoping I found such phenomenal lift that in the end I had to use dive brakes for some time just to get rid of my excess height. I arrived at Norrkoping exhausted. The first man to greet me was Paul who enquired what had happened to me and when I told him that I regretted ever having met him in the air, and explained that I was so low over the Swedish forest that I could see the famous Swedish trolls, he roared with laughter, and was obliged to inflate my life jacket to save myself from drowning in the cockpit because I sweated so much from exertion and fright while being so low.

The weather was not good for the next four days and so there was no flying. We used this time to go up to Stockholm which is indeed a lovely city.

Friday, July 14th. Order for the day : Distance and Height. The weather was most peculiar. The sky became dotted with tired looking cumulus cloud towards 11 and so I was launched only to fall down again after flying for about half an hour. I managed to get back to the Aerodrome and learned that several pilots had similar trouble. The ground organization on the aerodrome was so perfect that I was airborne again on tow within six minutes, and this time I was on my way after release. I set sail for the Baltic and got as far as east of Norrkoping, where I went into cloud and made good height. The weather looked promising only towards Lake Vattern and so I changed course towards it. Near Linkoping the sky was rapidly becoming overcast and the only sunlight I could discover was near Motala, but I arrived too late and had to land.

Saturday, July 15th. Order for the day : Goal Flight. This was the last day of the Competitions and bad weather coming in from the South made us fly north for the first time. I had picked Orsa as a goal, some 220 k.m.'s away and in picking it I had my doubts whether I could get there as it would mean head winds nearly all the way, but I thought ' what does it matter, you cannot win in any case and see how near you can get to your goal '. I got to Orsa without any trouble and I flattered myself that I must be quite good, but on arrival I found that there were already three planes on the ground, and thought to myself ' these chaps must also be very good.' By the end of the day sixteen planes had landed there, something I could not get over, but it just shows how good the flying was. We didn't know where the others had gone to, but none of us thought that anyone would fly further north because behind Orsa you have 120 k.m.'s of solid forest without any landing possibilities. Those of us who landed at Orsa knew that conditions were excellent, but we thought the odds of having the plane survive the trees too great to start on an upwind flight late in the afternoon.

All the pilots who had reached Orsa decided to go into town to celebrate having our birds in one piece, as it would take some considerable time for the trailers to arrive. At 7 o'clock there was still no news of a number of pilots and, of course, there was great speculation as to where Billy Nielson and Paul McCready had got to as they were both very close to each other in points, and this flight would decide the World Champion. Most of our crews had arrived by now and you can imagine the atmosphere in the little restaurant after having much food and wine, and the tension before we knew where Billy and Paul had finished up. Eventually news came through shortly before 9 o'clock that Billy had nearly made his goal of Optand, 427 k.m.'s from Orebro, an amazing performance and a flight of great daring. Paul was some 80 k.m.'s short of Billy's distance and with that—runner up.

We all set off together at about 11 o'clock, 16 trailers and their crews towards Orebro, and what a marvellous train it was. (*Continued page* 162)

A CASE OF STRONG TURBULENCE

By J. NEUMANN and U. SCHWARZ

Israel Meteorological Service

A CASE of unusually strong turbulence in the first three thousand feet above the surface near Lydda Airport (Israel) was reported by several pilots on the morning of April 18, 1950. The pilot of a small aircraft returned from a flight after having been nearly overturned in the air.

The case was all the more interesting since the meteorological flight close to the time of the reported turbulence showed the existence of an inversion of 4.6°C. from the screen up to 3,000 ft. The temperature distribution and winds up to 5,000 ft. as measured over Lydda Airport at 0900 L.T. (0700 G.M.T.) are given in Table 1.

TABLE 1.

Height above sea level	Temperature	Wind velocity Direction	Speed
.ft.	°C	° true	kt.
5,000	20.8	160	17
4,000	23.6	150	16
3,000	25.4	130	24
2,000	24.3	120	15
1,500	23.7	..	
1,000	23.1	Calm	
500	22.1	..	
Surface	20.8	290	6

The pilot balloon at 0400 showed north-easterly upper winds, and it would appear that between 0400 and 0900, during which period the winds veered to SE. (see Table I), a trough in the low-level easterlies passed the station from the east.* While the surface charts for the 18th indicated the 'protrusion northward of the Sudan trough (' Red Sea Trough '), the 700-mb. map for 0400 showed a cyclonic shear in a narrow zone between two anticyclones, a minor anticyclone to the west and a major anticyclone to the east.

Temperature and humidity changes at mountain stations, and the great difference in humidities between mountain stations and stations in the coastal area on the 17th demonstrated that a subsidence inversion was in the course of intensification and lowering. Thus, whilst on the 17th relative humidity at Jerusalem (Rephaim station, 2,526 ft.) dropped to 16 per cent. (with a maximum temperature of 29.1°C.), relative humidity in the coastal area was high. Low stratus developed over the latter and persisted near the coast throughout the 18th, the date of the reported turbulence.

One of the salient points of the pilot-balloon ascent (see above) is the strong wind shear between 1,000 and 2,000 ft. suggesting that the Richardson number

$$R_i = \frac{g}{T}\frac{\dfrac{\partial T}{\partial z} + \Gamma}{\left(\dfrac{\partial u}{\partial z}\right)^2 + \left(\dfrac{\partial v}{\partial z}\right)^2}$$

computed for that layer and compared with values of R_i considered as critical for the increase of turbulence may throw light on the intensification of turbulence on the morning of the 18th.

It appears from the meteorological flight that the lapse rate between 1,000 and 2,000 ft. was constant and, therefore, in the computation of $R_i \partial T/\partial z$ can be replaced by $\Delta T/\Delta z$, with $\Delta T = 1.2$°C. and $\Delta z = 1{,}000$ ft. $= 3 \times 10^4$ cm. (approximately). If we now accept that there was a calm at the 1,000-ft. level, we may orientate the x-axis of our co-ordinate system in the direction of 300° and obtain that $v = 0$ at 1,000 and 2,000 ft. Next, assume (*a*) that throughout the layer $v = 0$ and, therefore, $\partial v/\partial z = 0$, and (*b*) that it is justified to replace $\partial u/\partial z$ by $\Delta u/\Delta z$; then $\Delta u = 15$ kt. $= 772$ cm./sec. Thus we obtain

$$(R_i)_{1000-2000} = 0.70.$$

In the computation the quantity which is most likely to be in error and appreciably affect the value of R_i is Δu. Any error in Δu will magnify the error in the computed value of R_i in which the square of Δu appears.

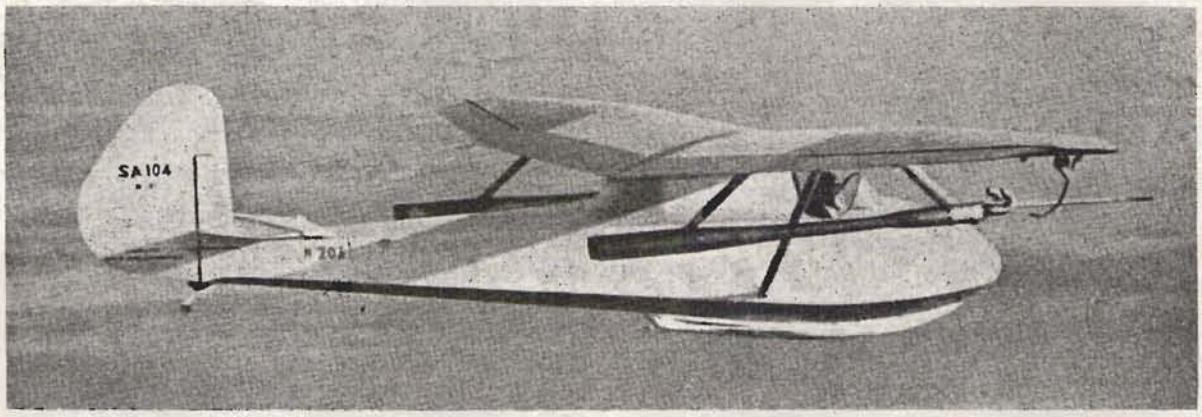
Assume that the correct value of Δu is greater than 15 kt. It is very unlikely that it would be so great as to make our R_i smaller than 0.15; in order for R_i to be 0.15 or less, the wind shear would have to be 32.4 kt. at least—an improbably large value in the circumstances. It is still less likely that the shear was so great as to make R_i 0.04 or less. It is recalled that values of R_i of 0.04 and 0.15 were considered to be ' critical ' by various writers.*

If, on the other hand, we assumed that the correct value of Δu is smaller than 15 kt., the resulting R_i would be greater than 0.70, and *a fortiori* greater than 0.15 or 0.04. It is in place here to quote O. G. Sutton : ' Thus at present some support can be found from meterological data for almost any value of Ri_{crit} between 0.04 and 1 . . . '

* As pointed out by Mr. L. Krown.

(*By kind permission of the Meteorological Magazine, December, 1950, and the Authors*).

PULSE-JET-PROPELLED GLIDER



THE Pulse Reactor S.N.E.C.M.A. ' Escopette ' installed in the ' Emouchet ' (French ' Grunau Baby ') is the first self-contained propellent in the world attached to a glider which enables flight, including take-off, without any movement of the installation or its parts.

No mechanical system is used to control the inlet of petrol but has kinds of aerodynamic valves which are moved by changes of energy in dynamic order. The number of pulsations is such that the thrust is practically continuous.

Characteristics :

Thrust, 10 kilos ; Consumption, 1.8 in. per kilo of thrust per hour ; Length, 2.85 metres ; Diameter, 0.155 metres ; Weight, 4.5 kilos.

Movement is obtained in the simplest manner by admitting a little air at the same time as one opens the throttle. The sparking plug doesn't come into operation until that moment.

The glider ' Emouchet ' is equipped with four pulse motors a group two-by-two under each wing, and placed in such a manner that (*a*) their discharge jet avoids the tail assembly and gives full protection against fire, whilst causing the minimum vibration. (*b*) that the radiation especially at the point of fixture has no effect on the structure or the covering of the glider. (*c*) that the rate of discharge of the pulse motors avoids undue strain on the fuselage especially at take-off.

The petrol tank is in the fuselage and petrol is pumped to each of the groups of pulse motors.

On the 30th November, the aircraft having been towed, flew with two pulse motors burning (which caused greater vibration than would have been the case with four motors automatically and oppositely coupled) yet no vibration was felt at any speed.

The subsequent flights made it possible to make some evaluation of the pressure of petrol required in relation to altitude and speed.

The results obtained were sufficiently encouraging to enable an early take-off by the machine under its own motive power.

The performances of the aircraft conformed to the estimates.

We look forward to hearing more news of the ' Emouchet ' which will be published in *Sailplane*.

SOUTHERN BIRD GOES NORTH—continued

Perhaps you can imagine what a train of 16 trailers looks like driving through the Swedish forests in twilight which, of course, goes on throughout the night. We all got back in good time for breakfast at Orebro, tired but happy, and looking forward to the next Championship.

I presume the next Championship will not be held in Sweden, this will be a relief because the country side to be flown over couldn't possibly have as many trees and lakes and so few places to land. But then again there is the possibility of it being in Finland, and judging by the Finns, who said that Sweden is open country, this really makes my blood curdle. However, where there is life there is hope, and wherever it might be held, no people could be more kind, considerate and such wonderful hosts as our dear Viking friends.

MODIFICATIONS TO SAILPLANES

By JOHN LOUFEK

Published in the June issue of 'The Thermal'

MANY of the two-place army surplus gliders in this country are being modified—or have been modified—by their owners in order to improve the comfort, appearance, and stability and control over that of the sailplane as originally manufactured.

Most glider owners, I believe, do not have enough information available to them to proceed safely with modifications to the structure or aerodynamics of their sailplane, even though they no doubt feel that they know what they are doing. In the aircraft industry the best men in an aerodynamics group will spend hundreds of hours in analysis to work out a design modification which is intended to improve an existing airplane. Then, after months of flight testing, the complete results of the change are determined. Other smaller change proposals are continually being studied in an effort to improve the airplane. Glider owners have no way of conducting tests on their glider to find the results of their modifications, and so *cannot* establish that the glider is still completely safe to fly.

The C.A.A. has been very lenient with glider owners in allowing modifications to be made without affecting the N.C. license of the sailplane. Although some major modifications have been presented to and approved by C.A.A. engineering, many gliders are licensed and flying with changes not on the records.

The proper installation of a shoulder harness is a structural example of a small modification. Unless the mechanic installing the shoulder harness runs a short stress analysis to determine a place in the aircraft that is strong enough to take the design load of the harness itself, a weak installation will result. In our 'LK' I had to tie into a cluster of tubes with $\frac{1}{8}$" cable, on each side of the ship, back of the rear seat, and had to use a *stainless steel* clamp around the largest tube in the fuselage to attach the front shoulder harness. A weaker installation, using an aluminium strap or attaching around a small tube, would tear out under a fraction of the design load—giving the pilot a false sense of security with his shoulder harness.

Aerodynamically, the field of stability and control is one of the most difficult in which to predict the results of a modification. Even top men in this field are often wrong in their estimates of what the results of a modification will be. The more one learns about stability and control of airplanes, the more cautious he becomes, because of respect built up by the increase in knowledge of the subject.

I do not like to see glider people modifying their sailplanes on the strength of what someone else has done, or because of what they have been led to believe will be a definite improvement to the sailplane. This is especially true of items which affect the stability and control of the glider, such as removal of control surface balance weights, changing control system gear ratios, removing or adding aerodynamic balance, adding springs to the control system, adding extra flaps, spoilers, control tabs, and so on.

All of the items listed above can be very helpful to an airplane if they are used properly when needed, but I am sure that some of these modifications will be unsafe when carried out in the individual manner thought best by each sailplane owner.

Sailplane & Glider 2/-

THE Directors of the Glider Press Limited regret to have to announce that as from the next (August) issue it will be necessary to raise the price of SAILPLANE AND GLIDER from 1/6d. per copy to 2/-, due to the increase in the cost of production.

The price of printing has increased twice during the last few months and another increase is expected during the next month owing to the high prices now having to be paid for paper.

The Directors expect soon to change the format and to have more pages per issue.

Subscriptions already in being will be honoured but fresh subscriptions received after August 5th will be 25/6d. per annum.

SMALL ADVERTISEMENTS

FOR SALE

' Cadet ' intermediate glider, immaculate condition, 12 months C. of A. £200. London Gliding Club, Dunstable, Beds. Tel. 419.

' Grunau Baby ' w/Trailer, ' Scud III ' w/Trailer, ' Tutor ' Glider as new, also ' Cadet.' R. Swinn, Resident Instructor, Yorkshire Gliding Club, Sutton, Thirsk, Yorks.

WANTED

URGENTLY REQUIRED.—May, August and November, 1944, issues of *Sailplane and Glider*, to complete set dating from Vol. 1, No. 1. Offers and price to Mrs. R. H. Haddock, Higher Hannaford, Landkey, Barnstaple, N. Devon.

Glider Towing Winch, full particulars to Box 274.

BREVITIES

A SAILFLYING Institute has been established at Cordoba, in the Argentine, under the direction of the Gliding Meteorologist, Walter Georgii and Reimar Horten, one of the famous Horten Brothers designers from Gottingen.

EXPERIMENTS with a new method of fog dispersal will begin this autumn under the sponsorship of United Air Lines.

One of the company's ' DC-3's ' is being equipped to diffuse chemicals designed to disperse fog and stratus cloud over limited areas.

United wishes to determine whether the method has a practical application to scheduled airline operations.

GERMAN Glider: First glider to be built in Western Germany since the war, the ' Esplenaub 34,' was flown recently at Essen-Mulheim. It was built by Gottlieb Esplenaub, whose glider plant was dismantled after the war.

NEW DISTANCE LEG REGULATION FOR SILVER ' C '

NEW regulations regarding the distance leg for the Silver ' C ' now allow it to be flown over an approximately equilateral triangle with sides of not less than 17 km.

A. H. Yates, who already holds a Silver ' C ' flew his ' Olympia,' as a test, from Dunstable to Cranfield, then to Henlow and back to Dunstable, on May 21.

In a W.S.W. wind of between 15 and 20 knots, he managed 14 miles N.N.W. of Cranfield in half-an-hour by crossing from one cloud street to another.

The downwind leg from there to Henlow was easy, the final leg, against the wind, taking two hours. This was mainly because Henlow thermals were so weak that he lost most of his upwind progress while climbing in each one.

It appears that this triangular course is not as easy as flying the same distance downwind.

THE DEVELOPMENT OF THE 'ROSS-JOHNSON 5' SAILPLANE—continued.

rebuilding these wings using wood ribs aft of the 50% spar, spaced at six inches. This portion will be fabric covered. The flight testing will resume when I get all the parts back together.

The construction and development labour hours are mounting, much as they did with the ' Tiny Mite.' First Ross has had his 2,200 hours and before its first flight I spent another 1,900 hours. This left the ship about 50% complete but flying in time for the Nationals in 1950. Since then another 1,000 hours are being spent, over the winter, to improve the wing and fillets. I estimate it will take another two winters of spare-time work to put the ship in its top aerodynamic condition.

LETTERS

GERMAN HOPE OF NATIONAL CONTEST

DEAR MR. BLUNT,

For your kind cable congratulating us on the rebirth of gliding in Germany, my very best thanks. Not yet all is in the very best order but we are happy, notwithstanding, seeing the goal not far away.

Just now, we wait for regulations expected from the Civil Aviation Board of the three Western Powers and hope, these will not bother too much a free development of our sport.

As long as we do not know these regulations, we cannot make exact plans, but we arranged all as well as we could and did really a lot of work during the last months and, especially in the last four weeks.

Just now, we only planned a glider-enthusiasts'

meeting on the 11th and 12th August in the Rhon-Mountains (city of Gersfeld) and Wasserkuppe, as we had during the last 4 years already.

If it can be done we intend to show there are some new two-seaters, but as construction just started these days, we doubt ourselves if they may be ready in time.

We are, of course very poor in our country and fear therefore that we must almost completely go back to group-building of gliders though we know that factory-building of gliders is better and also cheaper if you compare all factors, but, as we can better have workmen's free work done in our workshops than real money, we are forced to go the other way.

I do not believe that we will have a national meeting before the next year. The only national meeting we have on August 17th to 19th, is the National Championship of Models. We had the Model-Championship of our state, Wurttemberg-Baden on May 13 on the Hornberg, the first soaring site which was given back after the war from the Property-Control to the Deutscher Aero-Club. About 10,000 people took part; police-inspectors registrated 1,500 motorcycles and cars, among these many buses.

As soon as I know more and exact details, I shall be happy to inform you. I, myself, also Heini Dittmar and Ernst Jachtmann made our first real sailing-flights on April 29 in Saarbrucken, in French gliders which were offered to us from French pilots as a first sign of new co-operation.

Yours sincerely,
WOLF HIRTH.
Deutscher Aero-Club e.v.

DEAR SIR,

At 8.50, on May 24, many Bedford people witnessed a most unusual cloud formation. Perhaps some met. expert may be able to give an explanation of its cause.

There was an 8/8 overcast of strato-cu. and a southerly wind. A small east-west front appeared to be approaching from the south, moving quite fast. Its forward edge was uniform stratus, undercutting the main cloud cover, quite straight and clearly defined.

Two to three hundred yards behind its forward edge was a clearcut gap, perhaps 50 yards wide, running along the total length of the front. This gap sloped up and back into the dark stratus behind at an angle of 45 degrees. It was gently undulated along its length and sunlight was filtering down on to the lower side, from above. The rear clouds had the appearance of the crest of a lenticular.

The formation was remarkable for the precise width of the gap, the clearly defined surfaces of the clouds on either side, its length and straightness.

It was followed by a considerably increase in wind strength, with no appreciable veer, gradually thickening stratus and very heavy rainfall after a ½ hour.

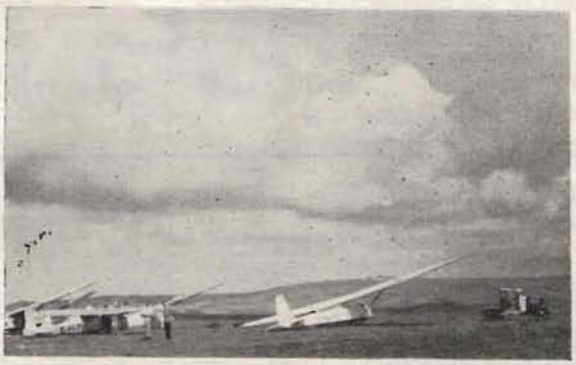
I would be interested to hear whether other glider enthusiasts saw this phenomenon and their views on it. I personally would have given a lot to have been airborne at the time.

Yours faithfully,
D. L. BARKER,
'Bleasby,' Ravensden,
Beds.

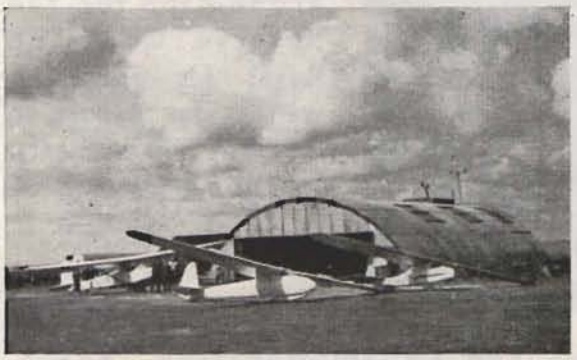
NEWS FROM THE CLUBS—

THE MYND IN PHOTOS

'Gracias,' Wingfield's 16-year-old 'Kite I' awaiting a turn



Preparation



Morning Parade on a perfect day

BRISTOL GLIDING CLUB

Some good soaring flights have been made at Lulsgate and Roundway in recent months.

J. D. Jones set the ball rolling with a climb to 6,000 feet from a 500 foot winch launch on 29th April.

May was a disappointing month with consistently wet week-ends but on June 2nd, C. H. D. Michell took the 'Tutor' to the unaccustomed height of 4,000 feet, unfortunately without barograph. The following day G. E. Miller completed his Silver 'C' at Roundway with a climb to 5,000 feet, while at Lulsgate, T. R. Young and J. D. Jones took a well deserved holiday from typewriter and workshop respectively and kept the two-seater at cloud base for three hours.

YEAR'S FIRST CROSS-COUNTRY

On 16th June, A. F. Gotch made the year's first cross-country with a 60 mile flight to Newbury, and the next day D. A. Colvin flew to Swindon.

We were also visited that day by Philip Wills and the Goodhart brothers. The 'Mu' ended up near Swindon but at the time of writing we have not heard of the whereabouts of the 'Weihe.'

J.N.C.

(As reported elsewhere in this issue Wills reached Coltishall to gain a 'Diamond.')

ARMY GLIDING CLUB

During recent weeks the weather has been kind to us at Lasham, and soaring hours have—soared.

Of course, Mondays have proved the best days of all, and it was on a Monday in May, the 21st to be precise, that our C.F.I. got away under ideal conditions, and inaugurated the Club's cross-country season by a flight of 140 miles to Lincoln. With the wind 70% off track, this was a highly commendable effort. Well done, Tony.

We have had several visits recently from the Surrey Club, by land, air (Auster) and air again, when Jack Hanan dropped in on the return leg of a trip from Redhill to points West in an 'Olympia.'

Membership has recently shown an encouraging trend, and there is some form of gliding activity now on most days of the week.

R.L.P.

ULSTER GLIDING CLUB

20th May. A day for circuits. Austin had the beach to himself and put in 9 flights before the tide was in. We can only describe the flying of this ex-R.A.F. pilot as immaculate. Needless to say he earned his 'B'.

27th May. In a 20 m.p.h. N.E. wind and rain, Austin, in the 'Tutor' took his 'C' in a 3-hour flight, surely one of the toughest 'C's' on record.

Sansom then went into the wet and outlasted the rain to soar to 3,000 ft., failing to see the messages written on the sand, he too had three hours. Then Liddell was launched at 7 p.m. in the 'Gull' and Cooper went off for his 'C.'

After half-an-hour Liddell had to open the brakes and dive out of the overcast at 4,200 ft. He descended to watch Cooper on his first soaring flight gain height to 2,600 ft. on an Easterly ridge that nobody had ever tried before.

EXTRAORDINARY CONDITIONS

' Gull ' and ' Tutor ' both landed after 1½ hours. Conditions were extraordinary, white caps showed waves as coming from N. ' Wind Sweeps ' showed surface wind from N.E. but from 2,000 ft. and up the wind was from 60°.

Over the sea there was no lift but a half-mile inland the lift was 6 ft./sec. Nearest Scottish coast is 50 miles due East.

The sky was completely overcast and featureless. We began to suspect a Venturi effect. With ground friction slowing the surface wind and possibly an inversion as a ceiling, the wind between was at least 36 m.p.h. being stronger at 2,000 ft. than at 4,000 ft.

This may have caused an upward funnel of air in which the gliders rose as in a lift shaft. Both Cooper and Austin (on a second flight) had great difficulty in soaring over the North cliff face but once inland and facing East the gliders rose rapidly.

2nd June. Routine training and Lieut. H. Stubbins getting his eye in, flying circuits. Weather not suitable for soaring.

10th June. As usual ' Sammy ' Sansom stole the show and floated around at 750 ft. for half-an-hour. Nobody else was able to stay aloft in the light North-Easterly breeze. Austin and Cooper put in circuits. Some of the members went lobster fishing on Saturday night ; so we have two strings now to our bow.

17th June. Aldergrove forecast N.W. wind for late evening and so it was. The tide was not out until 9 p.m. when ' Sammy ' Sansom went off for an hour and (as usual) reached 3,500 ft. over Benevenagh.

Cooper had 40 minutes in failing wind and light, and landed at 11 p.m. with Liddell who had 1¼ hours in the ' Gull.' A rain cloud drifted over Benevenagh and after it the wind backed to S.W. so it was possible to soar the S.W. slope.

The setting sun and crimson sky, the gathering darkness and the near-full moon over Benevenagh were a thing of beauty.

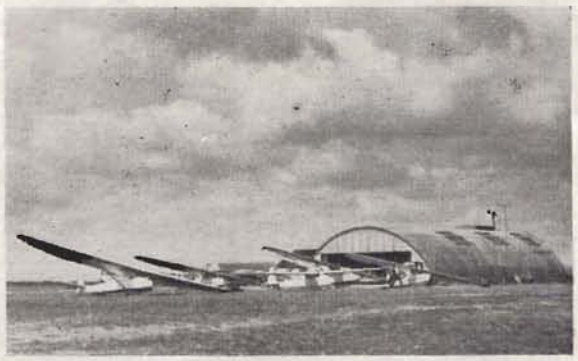
The air at the Downhill end of the beach was quite turbulent because of the wind shift. The machines were de-rigged at dark. We would like to pay homage to the ever willing Jim Bacon and his nephew Tommy Linton.

These two have been our driver and observer in the tow car for practically every flight for the last two years. Without their help in rigging, de-rigging, driving and retrieving, we would have lost many valuable gliding hours.

So far this year the ' Tutor ' and the ' Gull ' have put in a combined forty-three hours' soaring at week-ends thanks to the help of Jim and Tommy.

18th June. A westerly breeze lured Austin away from Derry, and picking up Osborne and Sansom at Eglington, reached Downhill at 8.15. Austin sportingly tossed for first flight and Osborne won and was launched by Jim Bacon at 9.15.

The ' Tutor ' just held its height until around Eagle Hill and then rose rapidly, which indicated a wind South of West. Osborne had a short beat and rose to 2,000 ft. and landed after 30 minutes. The wind was then very light and neither Austin (2 flights) nor Sansom could reach the area of lift ; however, we were all glad that Osborne had a soaring flight. It is rumoured that he may be posted, so let us hope that Magilligan may smile on him awhile before he leaves us.



ROYAL AERO CLUB CERTIFICATES

(Issued under delegation by the B.G.A.) MAY, 1951

CERTIFICATES - "A" .. 104 ((13111 to 13125 inclusive)
"B" .. 70
"C" .. 20
Silver "C" 10

"B" CERTIFICATES

No.	Name	A.T.C. School or G.C.	Date taken
11911	Bryan C. Hinsley	No. 22 G.S.	20. 5.51
12624	Ernest G. Ehrhardt	No. 31 G.S.	14. 5.51
12741	Douglas Purnell	No. 122 G.S.	20. 5.51
13100	David R. Cox	No. 123 G.S.	19. 5.51
13111	Albert A. Goodyear	No. 22 G.S.	21. 5.51
13115	Ronald F. West	London G.C.	24. 3.50
13118	James P. Dainty	R.A.F. Tech.	21. 7.50
13121	Frederick D. Thomas	No. 22 G.S.	1. 5.51

No.	Name	A.T.C. School or Gliding Club.	Date taken
13123	Peter J. Ford	No. 166 G.S.	20. 5.51
13125	Harold A. Simon	Coll. of Aer.	22. 4.50
13126	Clarence W. G. Sims	Halton App.	2.12.50
13132	David M. Jefferis	Hameln R.E.	7. 8.49
13137	Roger Mitchell	No. 31 G.S.	10. 9.50
13139	Ghulam S. Butt	R.E.F.C.	28. 4.51
13143	Derek M. Bolton	No. 2 Group R.A.F.	25. 8.46
13144	Donovan C. D. Wilson	Hereford G.C.	21. 4.51
13147	Bernard R. Wright	Bristol	12. 5.51
13152	Rowland Burton	No. 22 Det. Waltham	5. 3.50
13153	James Gemmell	No. 2 G.S.	12. 8.49
13154	Gordon A. Cornell	No. 105 G.S.	14. 5.51
13163	John Behague	No. 31 G.S.	11. 5.51
13164	John S. Mills	Newcastle	18. 9.49
13165	Raymond C. Crowe	No. 188 G.S.	13. 5.51
13166	Joy F. D. Mills	Bristol G.C.	13. 5.51
13167	Roy Reeve	R.A.F. Fassberg	26.11.50
13168	Peter J. Bradshaw	Fulmar G.C.	25. 3.51
13171	Maurice G. W. Pleasance	Cambridge U.D.C.	15. 6.50
13172	John E. Toon	Luneburg G.C.	10. 2.51
13177	Mary Candy	Bristol G.C.	13. 5.51
13178	Michael W. Newcombe	No. 5 G.S.	6. 5.51
13179	Philip Wright	Bristol G.C.	28 4.51.
13180	William Allsop	Derby & Lancs.	20. 5.51
13181	Leonard Cooper	No. 89 G.S.	27. 1.51
13182	John G. B. Daniell	Bristol	14. 5.51
13183	Geoffrey E. Harman	R.A.E. Tech.	22. 7.50
13185	Joseph G. Croshaw	No. 25 G.S.	14. 5.51
13187	Alan Jeffs	No. 42 G.S.	12. 5.51
13188	Stephen W. Tonkin	Bristol G.C.	19. 5.51
13189	Raymond Munns	No. 105 G.S.	20. 5.51
13194	Michael D. A. Jones	No. 1126 G.S.	14. 5.51
13195	Bernard O. Warmington	No. 82 G.S.	6. 1.51
13196	Jeffrey Dobbs	No. 49 G.S.	13. 5.51
13197	David C. Kerridge	Army Gliding Club	23. 5.51
13198	Dorothy C. Bell	H.Q., B.A.F.O.	4.11.49
13199	Charles N. Gall	No. 203 G.S.	25. 4.51
13200	David G. Wilson	Midland G.C.	20. 5.51
13206	George R. B. Whitaker	Derby & Lancs.	20. 5.51
13210	Douglas F. Halliday	No. 1 G.S.	25. 5.51
13212	Graham Fleming	Imperial Coll.	31.10.48
13215	Joan Downes	Portsmouth N.G.C.	29. 5.51
2091	Joseph A. K. Blades	Surrey G.C.	6. 5.51
4298	Geoffrey B. Tyler	Coll. of Aer.	12. 3.41
5109	Philip H. R. Philip	No. 166 G.S.	2. 5.51
6389	William W. Shorten	No. 203 G.S.	8. 4.51
7122	Bryan R. Webber	No. 84 G.S.	22. 4.51
7454	Derek P. W. Johnson	Surrey G.C.	16.11.47
9943	Edward J. Tidbury	B.A.F.O.	15. 4.51
10143	Stuart Greenhouse	No. 84 G.S.	22. 4.51
10938	Ronald W. Newstead	No. 122 G.S.	28. 1.51
11910	Roy Robinson	No. 22 G.S.	6. 5.51
12002	Colin J. Dyne	No. 122 G.S.	14. 1.51
12807	Patrick Riley	No. 125 G.S.	29. 4.51
12860	Alan M. Hinings	No. 125 G.S.	20. 5.51
12868	Thomas I. Samuel	No. 125 G.S.	14. 5.51
12928	John D. Chalmers	No. 5 G.S.	20. 5.51
12941	Harold A. Potter	No. 82 G.S.	15. 4.51
13072	Edward M. Slingsby	No. 23 G.S.	6. 5.51
13097	Peter Edgson	No. 123 G.S.	20. 5.51
13099	Clive J. Longworth	No. 123 G.S.	19. 5.51
13138	Peter St. J. Dawe	Halton App.	5. 5.51
	"C" CERTIFICATES		
4298	Geoffrey B. Tyler	Coll. of Aer.	12. 3.51
7887	Arthur C. E. Smale	Halton App.	29. 4.51
9943	Edward J. Tidbury	No. 130 G.S.	15. 4.51
10194	Robert T. Share	No. 168 G.S.	21. 4.51
10736	George A. Thomson	Scottish G.U.	6. 5.51
11467	David W. Ray	No. 89 G.S.	14. 4.51
11809	Vernon F. Gardener	Coll. of Aer.	5. 3.51
13115	Ronald F. West	London G.C.	2. 5.50
13125	Harold A. Simon	Coll. of Aer.	14. 4.51
13132	David M. Jefferis	Hameln R.E.	18. 13.50
13143	Derek M. Bolton	No. 2 Group R.A.F.	10.10.46
13163	John Behague	No. 31 G.S.	12. 5.51
13164	John S. Mills	Newcastle G.C.	15. 4.51
13167	Roy Reeve	R.A.F. Fassberg	12. 5.51
13171	Maurice G. W. Pleasance	Cambridge University	14. 3.51
13172	John E. Toon	Luneburg	22. 4.51
13195	Bernard O. Warmington	No. 82 G.S.	25. 3.51
13198	Dorothy C. Bell	H.Q., B.A.F.O.	16. 7.50
13212	Graham Fleming	Imp. Coll.	28. 5.49
12662	Alfred G. Riddle	London	7. 4.51
	SILVER "C's"		
309	R. F. West	London G.C.	14. 4.51
310	Miss M. May	B.A.F.O.	22. 4.51
311	G. A. Hookings	Auckland	11. 3.51
312	J. W. Lowrie	B.A.F.O.	22. 4.51
313	D. C. Stevens	Surrey	12. 5.51
314	A. E. Ashwell	Surrey	12. 5.51
315	R. Booth	Derby & Lancs.	19. 5.51
316	J. J. Davies	B.A.F.O.	19. 5.51
317	G. S. Nuemann	Cambridge	29. 5.51
318	D. Hughes	London G.C.	21. 5.51
319	S/L. R. Smyth	12 Group G.C.	25. 5.51

Do you know your airfields?

12

Recognize this airfield? It's No. 12 in this series of puzzle photographs. You'll find the answer below on the right.★

Whether you've brought in a Constellation or used up just a few yards of runway in an Auster, when you've taxied to the tarmac you'll get the same swift, cheerful service from the crews of the Shell and BP Aircraft Servicing Vehicles. The Shell and BP Aviation Service is on duty all year round at twenty-five aerodromes throughout the country.

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