Sailplane and Glider

The First Journal devoted to Soaring and Gliding

NOVEMBER 1951

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Sailplane and Glider

Founded in 1930

and ULTRA LIGHT AIRCRAFT

THE FIRST JOURNAL DEVOTED TO SOARING AND GLIDING

NOVEMBER 1951 ★ Vol XIX No 11

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The *Sailplane and Glider* is published on the 5th of every month. Price Two Shillings per copy: 25/6 per year posted. Advertising Rates on application.

Published for the licencees, Glider Press Ltd., by the Rolls House Publishing Co., Ltd., and Printed by The Mendip Press Ltd., London and Bath.

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COVER PHOTO:

Long Mynd, Church Stretton, site of Midland Gliding Club, Shropshire—from the hangar window. By D. B. Minterne, 1/300 f 5·6.

Editorial

THERE was one aspect of the National Competition which we thought might have been organised differently and in a way which would have been at the same time fairer and a better test of the pilots' practical meteorological knowledge. We refer to the order and times of starting of each individual pilot.

The method adopted was one by which lots were drawn on the first day and the list established was then rotated so that the later starters on the early days were the early starters on the last day and vice-versa. This meant, to take the last day for example, that the good conditions which obtained when Deane-Drummond made his dashing out-and-return flight, had ceased before 'Steve' could get back. But then 'Steve' did not start for an hour or so until Deane-Drummond had returned.

In Sweden, at the International Contests at Orebro in 1950, the time of starting was left entirely to the pilot. It is true that there were half-a-dozen tow-planes and less than thirty machines, whereas at Camphill there were at most three winches but it was claimed that these could have been organised to an average of twenty launches an hour or one every three minutes.

On one occasion at Orebro when a speed flight was announced, whereas Sigbert Maurer dashed off at 11 a.m. and took the first launch shortly after, Paul MacCready delayed his start until after 2 p.m. when he judged that conditions would be at their best. In fact his reading was right and he easily won the speed contest for the day with a speed of 83.8 km.p.h. The journey of 91 kms. took him a little over an hour, but Maurer took just under two hours. In fact it appeared that the conditions were even better later on in the afternoon when all the competitors were on their way home by road.

It must be clear from the above what we have in mind, and we hope that throughout the world future competitions will be organised after this fashion. After all a sport which depends upon meteorology for its existence should offer most scope to those competitors who understand it best.

If this idea and the skill necessary to accomplish it can be developed, together with the *expertise* in best air speeds, the time will arrive when instead of giving marks for height in cross-countries, marks may be deducted for excess of height above an average.

When high performance soaring reaches this stage it would appear that so far as competitions go, the limit in skill will have been reached. Because these two conditions will obtain even when the most difficult of tasks, that is, a Triangular Course Contest is attempted.

It seems to us that the tendencies required for these performances are already in existence and in foreseeable competitions in the next three years there may be tasks and organisation on these lines.

It may not be possible to adopt these ideas except that of the time of starting for the Spanish Meeting next year, but, these ideas must surely be considered for 1953.

We hear that Philip Wills has spent some time in Spain spying out the land, and in view of the fewness of roads round Monflorite and the lack of telephones, has raised the query as to whether the competition would not be difficult to organise in that area. An alternative venue has been suggested near Madrid, and this is under consideration by the Spanish Authorities. Lorne Welch has also spent some time in *Huesca* where he was a guest of the Commandant but in the space of ten or eleven days only managed to get some five hours soaring. He reports that the school is well equipped, but almost all of the flying is pupil-flying. Being some twenty-five miles or so south of the Pyrenees the site could offer facilities for Wave Flights in winds from the north, but the hazards of forced landings in the precipitous Pyrenees Valleys may make it necessary to prohibit any soaring over them.

The development of air-to-ground radio on a scale necessary to be completely serviceable is now within sight and it is to be hoped that the British Team will be not only equipped, but experienced in its use before the date of the competition. This would solve the problem of language to a large extent and of the lack of telephones. There are other problems in relation to the supposed visit of the British Team to Spain to be solved, not least that of finance, in which we hope the B.G.A. will be better advised than they were last year. No one yet has asked *Sailplane*'s help.

Germany's First Post-war Sailplane . . . .

'DOPPELRAAB'

A New Design By FRITZ RAAB

Simple—Cheap—Intermediate

THE 'DOPPELRAAB' is meant to be a simple and cheap intermediate sailplane of small dimensions and great ease of handling. Performance is intended to correspond to that of the 'Baby' class; the handling qualities are to be suitable for training purposes. The designer had in mind to create a handy, manageable trainer which can be flown as a two-seater, but has all the advantages of a single-seater, especially where the cost is concerned.

attach the dismantled parts quickly and safely to the fuselage. Further advantages are sturdiness and ease of handling on the ground. Other factors that contribute to the utility are good visibility for the pilots, favourable arrangements for instruction, simple maintenance, good accessibility to all parts which have to be inspected frequently, and a great number of apparently unimportant points.

All these considerations, together with the rich practical experience of an expert, led to the design of the 'Doppelraab.'

Prototype of the 'Doppelraab' which appeared at the Wasserkuppe Meeting at the Rhöhn in August

Fritz Raab took special care to facilitate the building of the aircraft by groups of amateurs. The former strength regulations have been complied with, so that safety in the air is guaranteed. Georg Kantz who is on the training sub-committee of the German Aero-Club (D.Ae.C.), worked out the requirements for such a two-seater from the instructor's point of view. A further aim in design was 'the sailplane of the greatest utility.'

UTILITY QUALITIES

There are various points which make up the utility of a glider. Performance and handling properties should cover the full range from ab-initio training up to advanced soaring. The utility is increased by moderate dimensions and simple rigging which can be done in two or three minutes by only a few people without tools, and which does not involve detachable parts. It should be possible to

CONSTRUCTIONAL DETAILS

The front part of the fuselage consists of a nacelle made of steel tubing. There is enough room behind the cockpit for a 'pillion.' The adjustable seat of a motor-cycle may be used for this purpose. The second pilot kneels on paddings and has sufficient freedom of movement to work the stick, release, and brakes over the shoulders of the man in front. His feet point backward and rest on pedals which are connected with the rudder-pedals of the front seat. For passenger flights these dual pedals can be disconnected. The second pilot's view is extremely good; the perspex hood extends as far back as the main spar.

INSTRUCTION VALUES

From the second seat the instructor can supervise his pupil very well, since he can see all his movements. The pupil, on the other hand, knows whether he

' has got her ' or whether the instructor is interfering. The communication between the two pilots is, of course, excellent. This new arrangement—the patent has been applied for—allows the concentration of the loading near the centre of gravity. The moment of inertia is thus kept small about all axes. The second pilot is located exactly in the centre of gravity so that there is no change in trim when the aircraft is flown solo.

A single landing wheel is provided to assist launching, landing and retrieving.

The tail end of the fuselage is a simple wooden structure of triangular section and consists of light bulkheads and three longerons covered with plywood. Rudder and tailplane are also made of wood. On derigging, the two halves of the tailplane are folded up against the rudder which always remains connected up.

SIMPLIFIED RIGGING

The struts are fixed to the fuselage by means of universal joints and to the wings by special bearings. These struts can be turned in order to increase the drag, and replace the usual type of brakes in the wings with all their fittings. This simplifies rigging, because the struts are folded up alongside the fuselage and there are no rods to be connected up to air-brakes.

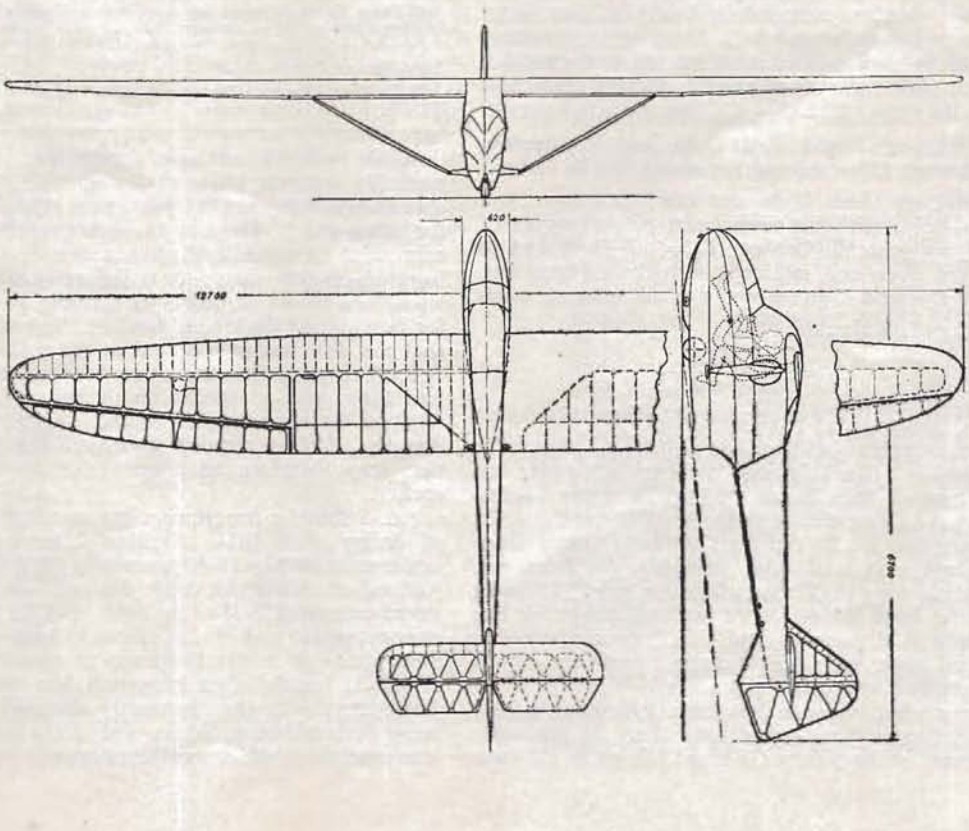
The wings are of single-spar, wooden construction, the differential ailerons being operated by cables and push-rods and the roof-fittings are shaped like handgrips in order to speed up rigging. The fittings are arranged in such a way that the wings cannot be removed unless the ailerons have been disconnected. Space in the nose between ribs 1 and 2 can be used for luggage. The dismantled wings rest on small blocks which also hold the undercarriage. If the wheels are kept in the fuselage the aircraft can be made roadworthy by using accessories only, which are carried on board. Three people are required to rig the sailplane in three minutes.

The variety of materials has been greatly limited in order to facilitate the supply for amateur builders. In cases where more difficult elements could not be avoided, detailed descriptions of the manufacture are given with the drawings which will be available after the test flights of the prototype have been completed. Drawings can be understood by the ordinary tradesman and are well provided with text and illustrations.

TECHNICAL DATA

Span, 42 ft.; Length, 22 ft.; Width of the fuselage, 24.5 inches; Wing area, 188 sq. ft.; Aspect ratio, 1 in 9; Weight empty, 330 lb.; Weight loaded, 704 lb.; Wing loading, flown solo, 2.6 lb./sq. ft.; flown as a two-seater, 3.7 lb./sq. ft.; Gliding angle, 1 in 18; Sinking speed, 3.1 ft./sec.

By kind permission of 'AERO'



The Design of Sailplanes for High Performance

An Analysis of the Basic Requirements for Maximum Performance in Thermal Soaring

Part II

By K. G. Wilkinson, B.Sc., D.I.C., A.F.R.Ae.S.

2.3 Comments on the Drag Polars

Amongst sailplanes with more conventional configurations, it is of interest that the most nearly linear relationship is shown by those with the highly cambered sections (Fafnir, Sperber Jr., Bussard, Präsident); as would be expected, these also tend to show the highest maximum lift coefficient although it is, even so, surprising to find values of nearly 1·6 (Sperber Jr., Fafnir). The poor performance of the N.A.C.A. sections on the D.30 above $C_L=1\cdot0$ is noteworthy. The moderately cambered sections (on Meise, Weihe and Gö 3 show a less drastic collapse at $C_L=1\cdot0$, but the increased slope of the drag curve around this value shows that a partial flow breakdown has occurred, as would be anticipated from the two-dimensional data for a similar section in Ref. 1. It is of interest that the lift coefficient for maximum glide ratio never exceeds the lift coefficient at which the slope of the $C_D-C_L{}^2$ line starts to increase.

2.4 Analysis of Flight Test Data and Comparison Between Observed and Estimated Profile Drag

In analysing these flight test results, it has been chosen to deal with the linear part of the curves of FIG. 4 (lying generally between $C_L=0\cdot2-1\cdot0$) and to resolve the slope and intercept with the C_L axis into values of C_{D_Z} and K given by the usual approximation to the drag of an aircraft:

$$C_D=C_{D_Z}+\frac{KC_L{}^2}{\pi A}$$

C_{D_Z} converted into the equivalent D_{100} (lb. at 100 f.p.s.) has been compared with estimated skin friction form drag in FIG. 5 (for reference numbers see TABLE II). Estimation has been based on R.Ae.S. Data Sheets, using Reynold's number equivalent to flight at $C_L=0\cdot2$, with transition at 20 per cent of wing chord from the leading edge and nose transition for fuselages. Appropriate wing thickness or fuselage length/diameter ratios have been taken. A 10 per cent allowance has been made in all cases to deal with drag increases due to control gaps, leaks and imperfect surfaces—effects not susceptible to precise estimation.

There is some evidence that transition on wings may in fact be somewhat farther back than 20 per cent; experiments at the Surrey Gliding Club on an Olympia (English built Meise) have shown that laminar flow probably extends back to the spar (30 per cent of chord), which is near the maximum thickness point at the wing root. These tests were carried out during calm evening conditions when a fine dew deposit was forming on the wings; the sailplane was launched by winch and flown as nearly as possible at the airspeed for best gliding angle until landing. Inspection showed that the dew had evaporated in the turbulent region. Several characteristic transition 'wedges' of dried wing had their apex at specks on the smooth ply-covered front of the wing, and aft of the spar the whole wing was dry. The assumption of uniform 20 per cent transition may therefore be conservative for this type of section.

FIG. 5 shows a progressive improvement in cleanness of design since 1931. Designs 2 to 6 (1933-5) are under-estimated by 15-40 per cent by the straightforward method of estimation used: designs 7-14 (1936-9) are under-estimated by 0-17 per cent. No. 15 is apparently over-estimated and No. 16 seems to have slipped back somewhat. It is not proposed to speculate on these results at length. One important fact may be noted, however; that is the apparently efficiency of the high wing designs Meise, Weihe and D30. It appears that these sacrifice nothing significant in performance relative

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(6) Hans Zacher. Ergebnisse der Leistungsmessung und Flugeigenschaftsprõfung des Segelflugzeuges D30 'Cirrus'. *Mitteilungen der Flugtechnischen Fachgruppen und Arbeitgemeinschaften Folge* 6/Sept. 1944.

(7) *Flugzeug Typenbuch*, 1944.

(8) Dr Karl O. Lange. Thermals at low altitudes. *Souring*, Sept.-Oct. 1945.

TABLE I
PRINCIPAL DATA FOR SAILPLANES WHICH HAVE BEEN PERFORMANCE TESTED

Type	Span (ft.)	Aspect Ratio	Test Flying Weight (lb.)	Wing Section (Root/Tip)	Year	Other Features
Falke	43·3	9·8	596	RRG	1931	Parasol, strutted, swept-back wing
Bussard	47·0	14·6	530	Go535	1933	High wing, open cockpit, cantilever
Präsident	52·5	14·0	597	RRG 13	1933	.. ..
Fafnir II	62·3	20·3	843	DFS	1934	Mid wing, enclosed .. .. ..
Sperber	50·0	15·2	632	Go535/Go409	1934	.. ..
Kranich	59·7	14·3	795	Go535	1935	.. ..
Sperber Senior	52·6	15·8	642	Go757/Go676	1936	.. ..
Sperber Junior	51·2	15·6	618	Go535/Go409	1936	.. ..
Go 3	55·8	15·2	735	Go681/Go693	1936	.. ..
Meise	49·2	15	497	Go549/Go676	1938	High .. ..
Olympia	49·2	15	630			(British built Meise)
Weihe	59·0	17·8	759	Go549/M12	1938	High wing, enclosed cockpit, cantilever
D.30	66·0	33·5	636	NACA 2414/4412	1938	.. .. pod and boom fuselage
H.IV	66·3	21·5	720	Reflexed	1939	Tailless, prone pilot position
*Reiher	62·5	18·6	726	Go549/676		Mid wing, flush canopy, cantilever
Gull IV	50·0	15·63	656		1946	High wing, enclosed cockpit, cantilever

Notes:

(1) * In the case of the Reiher, actual flight test points were not given, data being published as a faired curve—the reliability is therefore not known.

(2) Test flight weights given above do not always agree with weights quoted for standard aircraft.

to the mid or shoulder wing designs, Sperber Jr. and Fafnir (with their elaborate fillets or wing-body growths) although the gain in structural simplicity is great.

2.5 Comparison Between Observed and Ideal Induced Drag

The induced drag factor K has to cover several complications of which the most immediately obvious is the departure of load grading from elliptical; most sailplanes have straight tapered twisted wings which might be expected on theoretical grounds to produce a K of about 1·05. In addition to this, the decrease in Reynold's number between steady flight at $C_L=0{\cdot}2$ and $C_L=1{\cdot}0$ will, assuming constant transition, account for an increase in profile drag of about 10 per cent in a typical case. The change of velocity distribution will also produce form drag and skin friction changes which, in the absence of special accounting in calculation of profile drag, will appear in K when analysing flight data. This effect will vary with the design lift coefficient of the section; reference to the two dimensional data of Ref. 1 will show that with a low design lift coefficient (e.g. 23012), K may suffer an apparent increase of 20 per cent between $C_L=0{\cdot}2$ and 0·8 and over 30 per cent between $C_L=0{\cdot}2$ and $C_L=1{\cdot}0$, whereas with a moderate design lift coefficient (4412) the increase is negligible up to $C_L=0{\cdot}8$ and 20 per cent up to $C_L=1{\cdot}0$. In dealing with moderately cambered sections at lift coefficients less than 1·0 it is clear that $K=1{\cdot}15$ can be confidently expected with values increasing up to 1·35 or more for sections with low camber.

TABLE II
INDUCED DRAG EFFICIENCY FACTOR

Ref. No. (Fig. 5)	Type	K: High Wing	K: Mid or Shoulder Wing	K: Special Category
10	Meise	1·18		
2	Bussard	1·28		
3	Präsident	1·15		
13	D.30	1·10		
16	Gull IV	1·13		
12	Weihe	1·04		
11	Olympia	1·20		
8	Gö 3		1·10	
4	Fafnir II		1·22	
6	Sperber Senior		1·34	
5	Sperber		1·24	
7	Sperber Junior		1·33	
15	Reiher		1·24	
9	Kranich		1·20	
1	Falke			0·83 (Parasol layout with swept and highly twisted wing)
14	H. IV			1·45 (Tailless)
	Average	1·15	1·24	

Turning now to the sailplane drag polars we find the following values of K hold for that portion of the drag curve between $C_L=0{\cdot}2$ and the value for max. L/D, which as we noted earlier is the straight part of the curve in FIG. 4.

On this assessment it appears that the high wing layout has a clear superiority. The high value of K for the Horten IV is almost certainly due to the increase of profile drag of the elevons with C_L (they are deflected up to trim at high lift) and to the development of thick boundary layers at the wing tips.

To summarize the most important conclusions so far:

(1) Profile drag is likely to be estimated to within 15 per cent of the attained figure for well-designed modern types of sailplane using conventional methods for calculating component drags.

(2) For moderately cambered sections (Gö 549, N.A.C.A. 4415) lift coefficients approaching unity may be used without appreciable flow breakdown or increase in profile drag. Indeed up to this limit, the relationship between total C_D and C_L^2 is sensibly linear and can be estimated with sufficient accuracy for normal wings by applying a factor 1·15 to the theoretical 'elliptic' induced drag to arrive at the slope of the line.

(3) A high wing layout is not noticeably inferior in profile drag to the most carefully designed mid or shoulder wing configuration and has a distinct advantage in the matter of induced drag efficiency factor K. This may have nothing to do with induced drag but could conceivably arise from reduced interference between wing root and fuselage.

3. ESTIMATION OF STRUCTURE WEIGHTS

3.1 Objectives

Having found a method of estimating aerodynamic

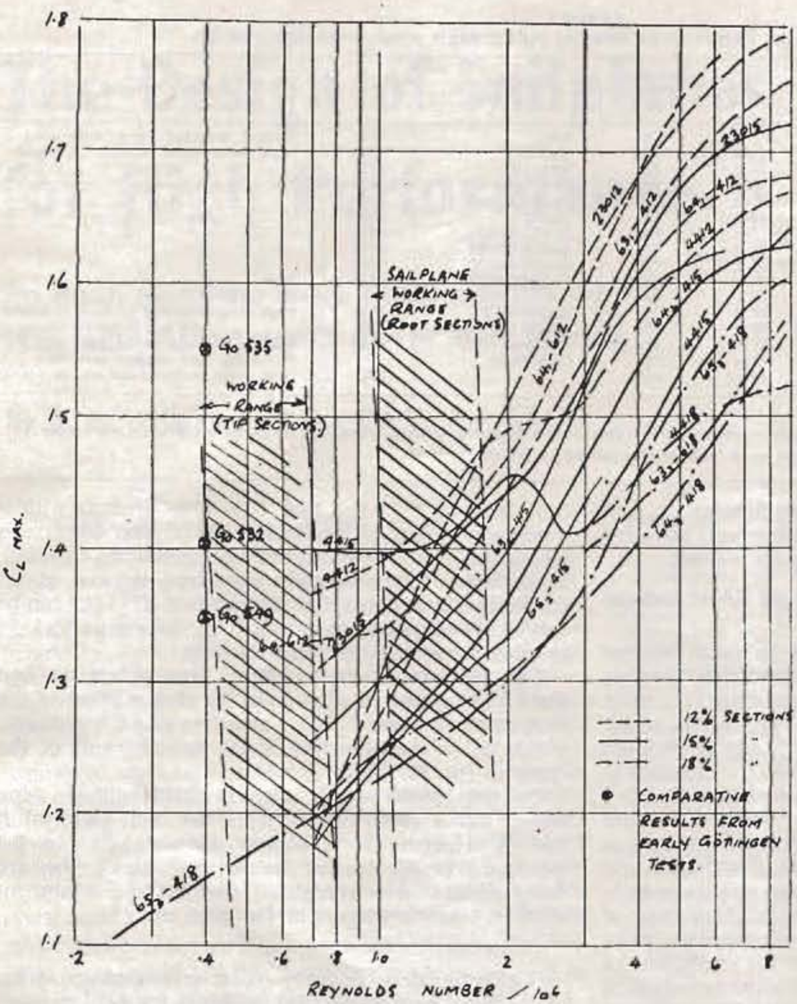


Fig. 3.—Maximum lift characteristics over a range of Reynolds Numbers from low turbulence tunnel tests

performance which is both simple and in good agreement with observed results, we have now to see whether structure weight is amenable to simple generalized representation. If this can be done it will be possible to describe the overall performance of sailplanes by simple relationships which lend themselves to analytical treatment.

A cursory inspection of past design activity shows wide difference in taste in such matters as the use of cantilever or strutted layout, taper ratio, wing thickness, span, method of construction and so forth. Most layouts for high performance sailplanes now incorporate a straight tapered cantilever wing with root thickness ratio about 15 per cent and about 3:1 taper ratio: this sacrifices little in aerodynamic efficiency compared with the optimum, lends itself to easy lofting and production, and has good structural efficiency. There remains a considerable possible variation in design load factor, structural method and material. In considering performance trends it is not satisfactory to fix the last two variables since larger spans will tend in the nature of things to bring with them more developed structural methods and possibly different materials (such as light alloy for wing spars). Such aircraft are expensive projects and it is reasonable to assume that a designer aiming for a larger and more specialized type will be prepared to take more care with structure design. At any rate, this has been so in the past.

From this argument it follows that estimation of structure weight trends should not be based on an assumption of structural similarity without examining past designs to see whether the assumption is justified. There are certain helpful aspects to such a study: for example, there is little variation in the payload—a single-seater is always designed to carry pilot plus parachute and a strictly limited range of equipment, contrasting with the great variety of arbitrary requirements for a powered aircraft. It is therefore possible to compare quite a large number of past designs on a common basis. Points of difficulty arise in the absence of complete data, in most cases, on such important things as design factors and maximum speeds, which have an important influence on structure weight.

In what follows, available data (Ref. 7 and various soaring magazines) is examined for single- and two-seater sailplanes and the trends compared with results

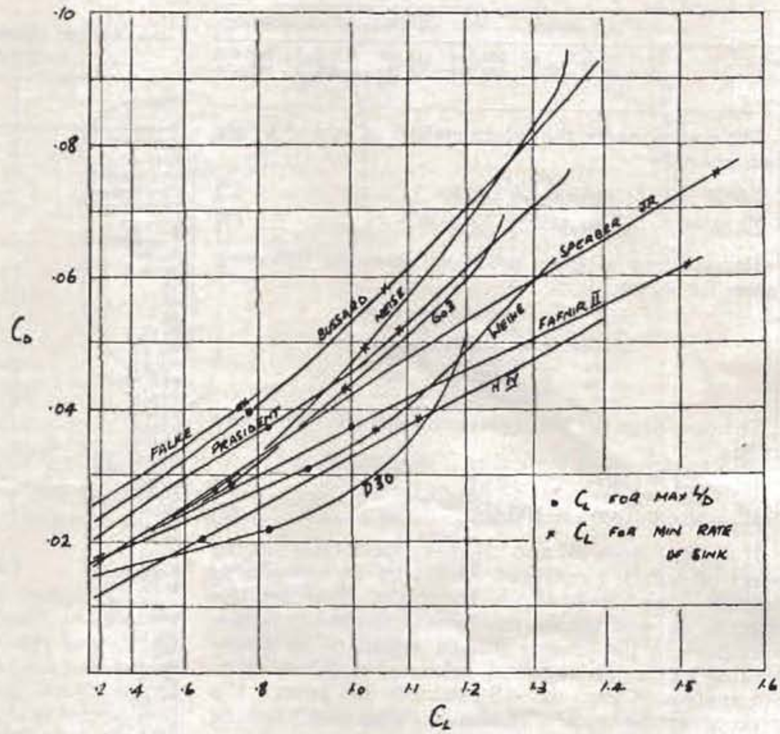


Fig. 4.—Coefficients for ten sailplanes measured in flight

expected on the assumption of similarity of structure.

3.2 Statistical Analysis of Equipped Weight

Principal data have been published for a large number of single-seat sailplanes. In TABLE III a selection has been made of 67 cantilever designs for medium or high performance. Span and aspect ratio are the only independent variables for which data are available in all cases, so the analysis has been made in the first place to show their influence on equipped weight.

It is first assumed that the relationship between the variables is of the form:

$$W_e = k_1 + k_2 b^n + k_3 Ab \quad (b = \text{Span}, A = \text{Aspect ratio}) \qquad (1)$$

The form of the term in A is chosen to give approximately the correct variation of influence with size. k_3 may be looked on as a partial differential coefficient with respect to aspect ratio, the analysis establishing a best mean value over the range covered in the sample. It is the object of the analysis to discover whether k_3 is significant; provided that the coefficient is small the exact form of the assumed relationship is not vitally important.

Values of n varying between 1 and 2 could be argued on theoretical grounds so it has been thought advisable to try both these indices and determine whether one gives a significantly better fit than the other.

The determination of the best values of k_1, k_2 and k_3 follows by the standard methods of regression analysis. Results of the calculation are given in the following tabulation. The summation sign Σ denotes summation relative to the mean value of the three quantities W_e, A and b.

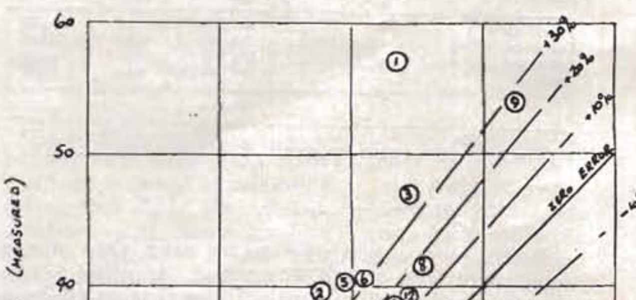


Fig. 5.—Comparison between measured and estimated form drag, showing aerodynamic cleanness (key to numbering is in Table II)

	$\Sigma(b^n)^2$	$\Sigma(Ab)^2$	ΣWe^2	$\Sigma b^n(Ab)$	$\Sigma b^n We$	$\Sigma(Ab)We$
$n=1$	3,940·03	5,957,565	686,960	112,120	38,860·9	908,474
$n=2$	3,373·67	5,957,565	686,960	107,201	36,642·9	908,474
.. ..	$\times 10^4$			$\times 10^2$	$\times 10^2$	

The equations for the determination of k_2 and k_3 are then given by:

$$\Sigma b^n W_e = k_2 \Sigma (b^n)^2 + k_3 \Sigma b^n (Ab) \quad \ldots\ldots\ldots\ldots\ldots \quad (2)$$

$$\Sigma (Ab) W_e = k_2 \Sigma b^n (Ab) + k_3 \Sigma (Ab)^2 \quad \ldots\ldots\ldots\ldots \quad (3)$$

The solution of these equations gives the following values for k_2 and k_3:

	$n=1$	$n=2$
k_2	11·85	0·140
k_3	−·070	−·100

The equations for the regression lines are then found to be:

$$W_e = -172 + b(11 \cdot 85 - \cdot 07A) \quad \ldots\ldots\ldots\ldots\ldots \quad (4)$$

$$W_e = 88 + 0 \cdot 14b^2 - 0 \cdot 100Ab \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

It appears from (4) and (5) that aspect ratio has the effect of reducing equipped weight by an appreciable amount. We should like to know how significant this effect is, i.e. whether the result could be due to random variations in the designs studied appearing in a misleading way as an apparent influence of aspect ratio. An analysis of variance will establish this point. We proceed in the usual way and establish the following table for the case of Equation (4).

Source of Variance	Sums of Squares	Degrees of freedom	Mean Squares
Explained by *b* ..	383,000	1	383,000
Explained by *A* ..	12,500	1	12,500
Explained by *b* and *A* together ..	395,500	—	—
Residual ..	291,460	64	4,550
Total	686,960		

The variance ratio between A and the residual is:

$$\frac{12{,}500}{4{,}550} = 2 \cdot 75 \qquad n_1 = 1, \; n_2 = 64$$

Reference to tables of variance ratio show that a significance level of 0·10 is reached. In other words, the chance of this result arising from random effects is about 10 per cent. It is therefore a reasonable assumption that increase in aspect ratio has a systematic effect in reducing structure weight.

The residual variance indicates a standard deviation of 67·5 lb. in any estimate of equipped weight made from Equation (4). Note that the formula is only valid over the range of data analysed. It can be applied with confidence, therefore, over a span range of 30 to 65 ft. with the aspect ratio correction factor covering a range of aspect ratio of 10—20.

Turning now to Equation (5) where b appears as a second power, we wish to know whether this gives a significantly better fit to the data than Equation (4). Analysis of variance shows a residual variance of 4,140 indicating that Equation (5) does, in fact, give a better fit with observed results. The variance ratio of the previous case compared with this is 1·1 ($n_1 = n_2 = 64$). This fails to reach a significance level of 0·20 and

TABLE III

DATA FOR SINGLE-SEAT CANTILEVER MEDIUM AND HIGH-PERFORMANCE SAILPLANES

	Span ft.	A.R.	Eq. Wt. lb.
Condor III	56·6	15	507
Weihe	59·0	17·7	430
Rhonsperber	50·2	17·6	357
Rhonbussard	46·9	14·6	364
Rhonadler	57·1	16·8	375
Olympia	49·2	15·0	353
Präsident	52·5	14·1	419
Reiher	62·3	18·6	525
Fafnir II	62·3	19·0	595
B8	49·2	14·4	364
B5	49·2	20·5	309
B6	52·5	17·5	342
C11	52·5	16	430
Mü 13	52·5	15·1	430
Mü 13*d*	52·5	15·9	375
FVA 10*b*	52·5	21·9	313
FVA 11	59	23·2	562
FVA 13	49·2	15·6	344
AFH 4	49·2	22·5	375
AFH 10	49·2	17·4	364
D30	65·6	33·4	386
D28*b*	36·4	12·6	159
FAB 3	52·5	17·1	397
Gö 3	55·8	15·2	503
Gott IV	52·5	16	386
Mowe	52·7	15·4	472
Helios	46	14	256
Schwalbe II	52·5	18	340
H 28 III	44·3	18·2	247
Kolibri B	39·4	13·3	243
EW 3	49·8	16·0	320
Mü 17	49·2	16·9	353
FI-D	54·5	19	287
FS-16	51·7	18·5	331
FS-17	32·8	8·3	199
FS 18*a*	59·1	18·0	441
Orlik	47·2	13·6	302
PWS 101	62·3	18·6	395
S 18T	43·7	13·5	218
Spyr III	52·5	19	218
Moswey II	45·3	15·7	251
Tulak GC	52·5	16	416
Duha II	52·5	16	427
VSB 35	59·1	18	405
Hjordis	50·9	21	317
King Kite	51·1	18	432
Atlante	52·5	15·5	328
AL/3	49·2	16·1	372
Air 100	59·1	17·6	532
PH 29	25·5	7·9	122
PH 33	36	10·7	199
I 23	43·9	12·9	358
Viking	61	15·8	510
Prue 160	36	17·3	185
Ross Ranger	44·7	18	210
Wanderlust	34	15·5	220
Moswey III	46	15·2	304
Spyr IV	54	16·5	398
S 18 III	46·6	16·5	342
Gull IV	50	15·6	464
Lunak	45·9	15·0	430
Zlin 25 (Sokaj)	49·1	16	364
Zlin 24 (Krajanck)	39·8	10·8	287
Elfe II	52	21·4	308
WLM I	45·9	14·1	430
I-21	51	15·7	470
SO-PI	52·5	16·0	550

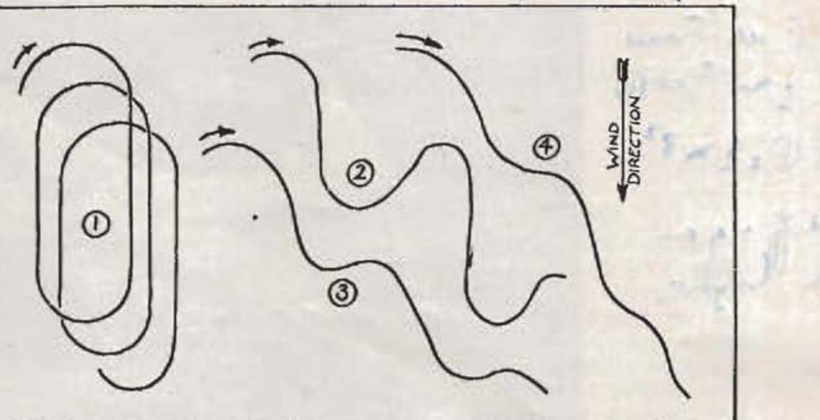
likelihood of the square law being more appropriate than the linear law is therefore much less than the likelihood that the aspect ratio effect is real. We can say that the available evidence does not favour the square law significantly. The reason that we can reach no firm conclusion in this matter is due to the fact that the bulk of the cases available for study cluster around the mean span of 50 ft. To establish n with any certainty we should need more examples of very small and very large span sailplanes.

The final part of K. G. Wilkinson's article, will appear in the December issue. It is reprinted by kind permission of 'Aircraft Engineering'

DYNAMIC SOARING

By

HEINZ KENSCHE



THE FLIGHT-PATH OF THE ALBATROSS WIND-SPEED RISING FROM ① TO ④
(REPRODUCED WITH SLIGHT MODIFICATIONS FROM THE BOOK BY PROF. IDRAC)

SOURCES OF ENERGY

MOST of the known sources of energy in the atmosphere have been utilized for soaring flight. There are slope-lift, thermal-lift originating from the heating of the ground, front-lift caused by the advance of colder air, cloud-lift which draws its energy from the latent heat of condensation, and wave-lift found down-wind of obstructions. In all these cases there is a vertical component in the motion of the air, and the flying technique of trying to stay within the range of the vertical flow is called static soaring.

Further sources of energy in moving air were detected very early, and their use for soaring flight has been eagerly discussed by well-known scientists. The first one of these possibilities is gust energy which is caused by turbulence set up by the friction of air particles against one another, and which is superimposed on the kinetic energy of a mass of air flowing at a mean velocity. The second source arises when horizontal layers of air on top of one another move at different velocities. This may either be caused by friction against the ground which tends to slow down the layer in contact with it, or by friction between a moving and a stationary layer, as in the case of inversions.

WIND GRADIENT ENERGY

Quite frequently it has been observed with certainty that big sea birds, especially the albatross, use the wind gradient close to the water surface to soar for several days without flapping their wings. This proves that the energy in the wind gradient is sufficient at least for large sea birds to soar. Soaring flights in inversions or bird flights where height was maintained or gained on horizontal gusts have not yet been observed. Scientists, who believe to have made such observations and had them published, have either laboured under an error or used inadequate equipment. In any case, there is no such publication known which is not based on faulty observation or which cannot be explained in terms of facts now familar to us. The kind of soaring which draws, or tries to draw, energy from the atmosphere in the way explained above is called dynamic soaring.

DYNAMIC SOARING AND BIRDS

We shall first consider the type of dynamic soaring which is already employed by birds and which may be possible for us as well. The French professor P. Idrac undertook a longer voyage in the Southern Pacific in order to observe the albatross, and in his book on experimental investigations into soaring flight he describes the soaring of this bird beautifully and with surprising accuracy and a good sense of flying technique.

Exhaustive mathematical research has established beyond any doubt that soaring flight on the wind gradient is possible according to our knowledge in mechanics. We can therefore assume that the albatross and other sea-birds actually draw the energy to soar from the relative velocity between two layers of air, and not from any other mysterious and unknown source.

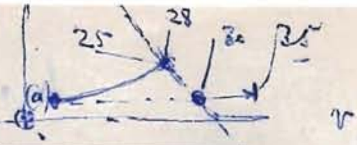
Now, the albatross soars in the following way: First it flies very close to the water, almost touching the surface and possibly keeping in the depression between two waves. Then the bird goes into a steep turn and as soon as it faces upwind it climbs almost in a straight line up to 30 or even 50 feet. After this the albatross turns to the right or left in an equally steep turn and glides down-wind or cross-wind back to the water surface from where the same thing begins all over again and is repeated for hours or days on end. And all this is done without any flapping of the wings.

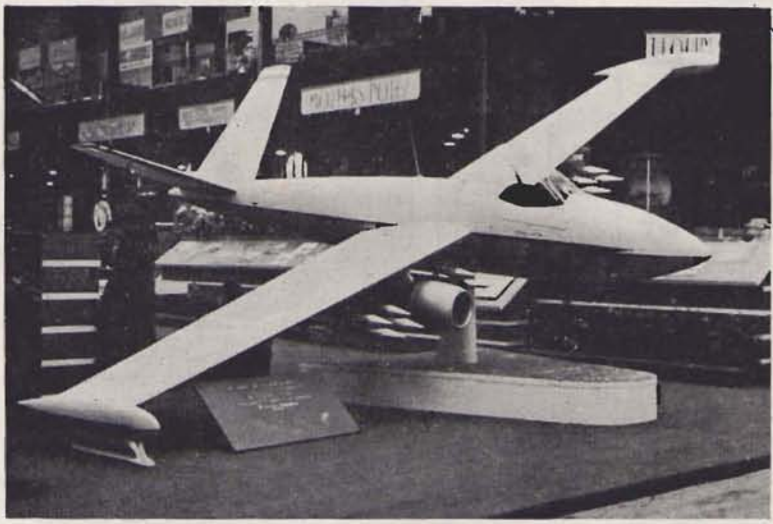
Without mathematical detail this is what happens: The increase of the wind speed is approximately proportional to the 6th root of the height. When the bird passes from lower to higher layers with a small excess of speed, it continually gains kinetic energy

cf 'Sailplane,' February, 1945—'Deep Water Birds and Gust Soaring,' by Captain L. C. Dugdale; and September, 1945—'Soaring Birds,' by J. H. Storer

K = ½ mv².

(KE rel ground = ½ m 5². at (a)
at (b) = ½ m.3².
diff = gain in height.





Originally a glider, the 'Fouga C.M. 8-2R Lutin' has been turned into a ground attack fighter by the addition of two jet-propulsion units and sixteen rockets, fitted in fours on either side of the jet units.

(Photo taken at Paris Show by 'Alata')

relative to the air by which it is surrounded at any given moment. This kinetic energy is used for further climbing until a height is reached where the gain of energy is just sufficient to maintain level flight. At this moment the turn is flown.

Gliding down-wind the bird again gains energy by the increase of its relative velocity towards the lower and slower layers, and this energy is now used for the turn into wind and the initial climb. Since the wind gradient is greatest close to the surface, the bird tries to go down as low as possible.

According to Idrac's observations the possibility of dynamic soaring arises for the albatross with a mean wind speed of 15 m.p.h. at 35 feet. In this wind the bird will have to exploit every opportunity. In a stronger wind where the gradient is also greater the bird can afford to let a chance slip without running the risk of 'going to the bottom.' In these conditions there is no need to gain energy by gliding down-wind, it is sufficient to descend cross-wind so that turns of only 90 degrees are necessary. The flight path may take any of the forms shown in the drawing.

HOW WE CAN SOAR THIS WAY

We begin to wonder whether this kind of soaring is possible for us. The answer is yes. For this purpose we require a small, easily manageable and aerobatic sailplane with a good gliding angle and a high wing loading. In an article in the Annual 1935 of the Lilienthal Society, Professor Prandtl confirmed this possibility. Applying Froude's Law of Comparison, he compared the albatross with a sailplane and arrived at the following characteristics:—

Span ..	.. approx.	35 feet
Wing area ..	,,	70 sq. ft.
Weight loaded	,,	675 lbs.
Wing loading	,,	9.5 lbs./sq. ft.

With such an aircraft dynamic soaring could be done in a wind of 35 m.p.h. at 130 feet which would be the attainable altitude.

No doubt, one day somebody will carry out this 'dice' and thus furnish the experimental proof of our theory by a short flight. But the value of this technique is questionable. Even the best pilot would not stand these highly accurate turns for longer than an hour, apart from the fact that the slightest mistake will most certainly be dangerous.

It would be a different proposition if dynamic soaring could be done in inversions. Meteorological observations of the boundary layers of inversions have undoubtedly been made, but unfortunately the results have not yet been worked out for our purposes, so that we cannot commit ourselves to say whether the energy would be sufficient for dynamic soaring.

Often in autumn, early in the morning after a starlit night we can recognise these boundary layers by the smoke rising up to 500-700 feet and then being blown away at a high horizontal speed, indicating the inversion over a long distance. In view of this phenomenon we should think the energy is great enough. Let us hope one of our meteorologists will find time enough one day to go through all balloon observations and pick out the data on wind gradients and dimensions of layers which are of interest to us.

A FURTHER DYNAMIC EFFECT

An example of another way how to extract energy from the wind gradient is worth mentioning here in order to point out a further dynamic effect. On speed tests aeroplanes were flown at full throttle at a constant height of about 300 feet, first exactly upwind and then downwind. It showed that the readings of the airspeed indicator and revolution meter were always slightly higher on the upwind course than they were on the down-wind flight. What is the reason for this higher speed performance?

The lift of a wing depends on the strength of the circulation round it. Now, since the windspeed increases with the height we get a faster airflow on the upper side of the wing than underneath, and this gives us a stronger circulation and therefore more lift. We can now maintain the same height with a smaller angle of attack and this results in a greater speed. Please note that the (*continued on page 260*)

SOARING IN FRANCE — THE BEYNES-THIVERVAL GLIDING CENTRE

By GUY BORGÉ

DURING my holidays in August this year I visited the Centre of Beynes-Thiverval, near Paris, for several reasons. I had never soared in the Paris country (in August the S.A.L.S. organized the 'Journées Expérimentales de Vol sans Moteur' in order to pick the French Team to enter the 1952 Huesca contests in Spain), and I wished to try to sail the distance Beynes-Biarritz for the Izarra Cup.

Unfortunately the 'Journées Expérimentales' were cancelled, and on no single occasion did a north-east wind prevail in August, only west or south-west winds, and the Izarra Cup appeared impossible.

Apart from these little misfortunes, I had the opportunity to explore the famous Centre of Beynes which occupies a great place in French Soaring.

Its history begins in 1932, when the pilots of the old 'Club Aéronautique Universitaire,' founded in 1929 by Pierre Massenet and Raymond Jarlaud, were seeking in the Paris country some favourable slopes, the only actual possibilities then known, to get some good ascending currents.

SHORT GLIDES AND HOPS

They found a field near the National Agricultural School at Beynes-Thiverval, 25 miles from Paris, surrounded by two small slopes. At first activities had to be confined to short glides and hops for 'A' and 'B' badges. In 1933 the Club owned a superb 'Avia 20' two-seater (a nacelled primary with two seats in tandem), and the new 'B' holders were given some lessons for improving their training.

At the end of 1934, the Club Aéronautiqué Universitaire, owned an impressive fleet: one 'Avia 11,' a 'Sulky' (nacelled primaries), one 'Avia 15' (nacelled primary), two 'Avia 32's' in the training class, the 'Avia 20' two-seater and a 20-h.p. motor glider 'Avia 50.'

By 1937 Beynes became a Regional Centre for the Paris area and many pilots took Silver 'C' legs in the 'Avia 40' which was available.

In 1938 Eric Nessler, the famous champion, broke

Top: *Good cumulus for high-performance sailplanes.*

Bottom: *The 'Emouchet SA-104' ready to start.*

(Photos by Guy Borgé)

the French distance record from Beynes and took the first French 186 miles leg. In the following year he accomplished an extraordinary distance of 237 miles and his flight proved how good was the Beynes situation for long travels.

The Centre was opened in 1940 for a few months, but very quickly closed at the German invasion. Five years later, it started life again as a National Centre, receiving numerous ex-German performance sailplanes, in which 11 distance records were broken during this year. But the following year was not so successful, only four distance records being broken.

In 1947 the Beynes pilots began to execute intensive cloud flying into cumulonimbus and five altitude legs of the Gold ' C ' were acquired. The International Contests were held in 1948 and there were some remarkable performances—three distance records being broken.

In 1949 the Centre came under a new form of organization to become the Saint Cyr-Beynes Inter-Clubs Centre and received permission to train from beginners to performance standard, members of 12 Paris Aéro-Clubs. Weather was perfect, even extraordinary, and six new distance records were broken. Last year was less favourable, three new distance records ; the same number of launches as in 1949 (15;831), but the soaring hours decreased by 700. This year is marked by very bad weather, and up to the 20th August only one Gold ' C ' distance has been taken. Organizer of the splendid Regional Contest was M. Eric Nessler who was the first to make a Diamond climb at Beynes.

The activities since 1945 are resumed in the following figures. Relative data for pre-war years is not available.

	Hours	Launches	'B'	'C'	Legs Silver 'C'	Silver 'C'	Distance Legs Gold 'C'	Alt. Legs Gold 'C'	Gold 'C' complete
1945	2,729	5,152	15	23	24	9	3		3
1946	2,869	12,824	31	40	24	3	1		
1947	2,627	8,919	13	22	49	18	5	5	
1948	3,808	8,471	2	12	54	14	9	2	6
1949	4,115	15,360	30	23	72	24	16	5	7
1950	3,434	15,831	44	25	36		4	1	
Total	19,582	66,557	135	145	259	68	38	13	16

The Centre is directed by M. Héron with instructors Mrs. Choisnet-Gohard, Messrs. Kirschroth, Nicaise, Rémande. From its previous title of a National Centre it kept an abundant fleet of about 30 sailplanes, very rich in performance machines :

Two-seaters.—Three ' C-800 ', three ' Kranichs ' (completely equipped with dual artificial horizons for blind flying instruction), one ' Castel 25,' one ' C.M. 7.'

Training Class.—One ' Grünau 2a,' two ' Grünaus 2b,' two ' Nord 1300,' one ' Emouchet SA 103,' one ' Emouchet SA 104,' one Castel 310.'

Performance Class.—One ' Meise,' four ' Nord 2000,' one ' Mü 13,' one ' Avia 40,' three ' Weihes,' two ' Air 100.'

In 1932 the Beynes site was chosen because of the hills facing the frequent south-west winds although the landing strip was situated across these winds. This fact has become a nuisance for instruction since the slopes, being very low, with some short beats, were dangerous for several sailplanes in flight at the same time. They are no longer used. But the landing strip remains across the wind with heavy down-draughts from the slopes during landing procedure. Therefore Beynes does not appear as an easy airfield for the beginner and the instructors have a hard job to teach their pupils.

Successive order of machines is similar to that used in the other Centres, apart from beginners' solos :—

1. ' C.800 ' two-seater
2. ' Nord 1300 Baby '
3. ' Grünau ' (belly hook)
4. ' Emouchet SA 103 '
5. ' Emouchet SA 104 '
6. ' Castel 310 '
7. ' Nord 2000 '
8. ' Avia 40 '
9. ' Mü 13 '
10. ' Weihe '
11. ' Air 100 '

ARRANGEMENT AND COST

Each pupil is registered by his own Aéro-Club for flying on a determined day each week. Monthly subscription consists of 1,200 francs (£1. 4s.), for the under 21-year-old pupils, and 1,500 francs (£1. 10s.), for others. For each additional solo there is a supplement of 220 francs.

These subscriptions cover petrol and people appointed by the Centre, apart from the instructors directly paid by the S.A.L.S. Sailplanes, aero-tow planes, winches, trailers, insurances, are also borne by S.A.L.S. A special bus, free for the pupils, starts each morning at 8 a.m. from the Paris Saint-Lazare station, and travels to Beynes in about one hour.

Great speciality of Beynes appears to be distance flights. Like the Centre at Pont Saint Vincent, already described in *Sailplane*, best winds giving the longest travels are in the north-east and the south-west, because they offer strength, instability and often formation of cloud streets. In north-east winds the best distances already registered are as follows :—

291 *miles* on the 13th May, 1949, by Lepanse in a ' Bréguet 900 ' from Beynes to Hourtin. A goal flight in 7 hours 10 minutes.

276 *miles* by the same pilot in the same machine to Landes de Bussac on the 12th August, 1949, in

' KESTREL ' IN WESTERN AUSTRALIA

Ric New and the ' Kestrel.' Modifications to neck and full canopy have vastly improved performance. Previously the ' Kestrel ' had a poor gliding angle, no doubt due to turbulence around neck and cockpit.

7 hours 27 minutes.

270 *miles* on the 7th July, 1946, by Gasnier in a 'Weihe' to Saint Bonnet sur Gironde in 7 hours 52 minutes.

263 *miles* on the 25th July, 1949, by Nessler and Bourguet in a 'C.M. 7' two-seater to Barbézieux in 6 hours 30 minutes.

260 *miles* on the 12th May, 1949, by Ruf in a Nord 2000 'Olympia' in 6 hours 46 minutes.

Certain flights seem extremely fast; for instance the flight of Rousselet on the 24th June, 1949, in a 'Nord 2000' timed 5 hours along 234 *miles* which represents an average speed of 47 m.p.h.

In south-west winds, distances remain limited because of landings in Germany. A very representative day was the 20th July, 1945, when Lepanse in a 'Spalinger S.18' reached Aix La Chapelle, his goal, 234 miles from Beynes. Gasnier sailed to Liège (203 miles), another goal, and Marcelle Choisnet to Soignies in Belgium (155 miles) breaking the international feminine record of goal distance. Another good performance belongs to Vinsonneau when his 'Mü I3' carried him to Luxembourg to cover 201 miles in 4 hours 50 minutes at an average speed of 43 m.p.h.

In the west wind, mention must be made of the 187 miles covered by Rosset in a 'Weihe' in the excellent time of 3 hours 45 minutes, giving an average speed of 50 m.p.h.

But with north or north-west winds which are never strong, slowness becomes noticeable. For example, Pechaud has travelled the 195 miles from Beynes to Vichy in the long time of 8 hours 26 minutes in a 'Meise,' landing at 7.50 p.m.

THE GOAL WAS LONDON

A very interesting flight in a direction towards north, on the 20th August, 1950, was made by Nessler who wanted to cross the Channel and to reach his goal of London. He reached the sea at Calais after 146 miles but judged his altitude insufficient to risk the passage.

It is perhaps good advice for prospective travellers towards England that a small placard has been painted in the middle of the Channel on the great map of the Beynes flying control: 'prière de ne pas se poser ici', or translated: 'please don't land here.'

Since 1946 it has appeared possible to execute at Beynes some Gold 'C' altitudes inside clouds and to achieve complete badges on the same airfield, without for instance going to Saint Auban for that purpose. But Beynes occupies a bad strategical position just between the ranges of Le Bourget and Orly airfields, and any soaring inside the clouds is forbidden by authorities. The sailplane pilots must then—if they wish to obey to these official rules, which they don't always respect—enter the clouds very far from Beynes, 25 miles at least.

For duration flights, as already written in the article, the slopes remain forbidden and unused; pilots execute long timed flights only by thermals. Here are the figures of the Beynes local records :—

22nd July, 1949—Miss Delécolle—8 hours 3 minutes in a 'Nord 2000.'

On the same day—Menjuc—8 hours 13 minutes in a 'Meise.'

4th August, 1949—Mattern—8 hours 28 minutes in a 'Weihe.'

19th June, 1951—Braunswick—8 hours 41 minutes in an 'Air 100.'

Numerous foreign pilots know Beynes and have flown in its sailplanes, coming from Austria, Belgium, Canada, Cuba, Denmark, Egypt, England, Finland, Germany, Netherlands, Norway, South Africa, Sweden and Switzerland. Several amongst them took some badges and legs. For instance, James (England) attained 10,900 feet in a 'Nord 2000'; Staff (Sweden) recording the excellent speed of 43 m.p.h. in an 'Air 100' to his goal of Metz (193 miles); René Comte (Switzerland) with 197 miles in the same 'Air 100'; Schachenmann (Switzerland), 191 miles in a 'Weihe'; Godinat (Switzerland), 222 miles in an 'Air 100'; and Maurer (Switzerland), 189 miles in a 'Weihe.'

But besides performances or records another interest arises from stays at Beynes, proximity of Versailles and Paris which present to their visitors many attractive sides, which are far from negligible.

GLIDING REORGANISED IN ARGENTINE

Research Institute Founded

IN March, 1951, 100 Argentine glider pilots met at Rumipal (Province of Cordoba), representing 30 Clubs in all parts of the Republic. Chairman of the meeting was the Argentine Minister of Aviation, R. Ojeda, the young and dynamic friend of powerless flight. Among the people present were the famous experts Professor Walter Georgii, Dr. Reimar Horten, and from the Italian side Plinio Rovesti and Adriano Mantelli.

Members of the conference suggested to Minister Ojeda the reorganization of gliding in the Argentine and the formation of a national institute for research in soaring flight. The foundation stone has already been laid at the spurs of the hills of Cordoba, near the Rio Terceiro.

WELL-KNOWN OFFICIALS

Well-known meteorologist Professor Walter Georgii is in charge of the institute, and the Argentine and South American gliding champion, José Ortner, who is also the President of the leading Club of the country, is the Vice-President.

The department of experimental construction will be under Dr. Reimar Horten who is known for his designs of tail-less gliders. Commandant Mantelli will be the test-pilot of the institute and also take charge of the department 'powered sailplanes.' The instructors' panel will be headed by the well-known Italian flying instructor Claudio Dori.

THE SUNBEAM

Reimar Horten built a two-seater, the HO-XV 'Glen Antu' (Sunbeam) which has been tested at

(*Continued on page* 262)

THE PRINCIPLE OF THERMALS

By H. WERMOUTH JENSEN

SINCE the principle of thermals was made out, conditions have not changed essentially, and the drawings which are being applied to illustrate course and appearance are on the whole similar to those applied in the thirties.

Experience has gradually proved that the whole thing is much more complicated than generally presumed. Among other things the World Championships gave evidence that it is not indifferent to which side you curve in the thermals.

It has been known for a long time that the up-currents rotated, and many people have seen how rotating pillars can rise in the air on a hot day. In their most violent form the rotating winds appear as water-spouts, but in this case it is no longer dust that makes the winds visible but on the contrary vapour which is being condensed on account of the suppressure arising in the middle of the pillar in consequence of the centrifugal power.

In order to understand why the winds are rotating an example may be taken from the water. By making an experiment in a tank with an outlet in the middle, it will be seen that a funnel-shaped hollow is formed on the surface, and if there are any uncleannesses in the water, it can be seen that the rotations go faster and faster the more they approach the centre of the outlet. The rotation is due to the fact that water particles moving towards the outlet will always get an impulse to one or the other side and thus not move directly towards the centre of the outlet. The consequence is that according to the act of inertia the water particles will try to pass the centre, but are being turned off along a spiral line gradually towards the centre.

As soon as the rotation starts the subsequent water will be turned off by the already rotating water, and by degrees all the water which moves towards the outlet will start rotating. When the water moves towards the outlet while rotating, the speed will increase to the effect that the rate is inversely proportional to the distance from the centre, i.e. that the tangential speed half-way is twice as big as in the periphery, with due regard to friction, etc.

The radiation which comes from the sun is extremely short-waved and penetrates the air without losing any power worth mentioning, i.e. that it hardly heats the air. When, however, it hits the earth, it will be braked and the brake involves that the earth is getting warmer. Now the earth will send out long-waved heat-waves which can partly be braked by the air, and this is now getting warm, warmest immediately above the surface. An example taken from the offprint of H. Henriksen from the periodical " Elementa " on gliders and their sources of energy in the atmosphere, is described as being pretty representative of a warm summer day.

The ground is 50.4°, the air in the altitude of 29 cm. 32.2°, of 54 cm. 30.0° and of 300 cm. 28.9°. These figures prove that the air at the ground has the very best conditions for being able to ascend as the difference of temperature between 29 and 54 corresponds to 900° per 100 m. and between 54 and 300 cm. 45° per 100 m. The drop in temperature in a mass of air which ascends in the atmosphere without meddling in the surrounding air is 1° per 100 metres as long as the air is dry. But why does the air not ascend immediately ? This is no doubt due to the fact that the comparatively small masses of air which incessantly try to free themselves will very quickly meddle in and emit their heat to the immediately surrounding and above air simultaneously with the fact that a certain force of appendage must exist between the air and the earth.

Celsius °

Now we have a very heavily warmed mass of air lying along the surface of the earth, let us call it ' pancake-thermals,' and reverting to the example concerning water, we think of a plane level above our heads under which water is drifting quite slowly but not so much as to make it drip or run from the level. Now we are increasing the admission of water until it drips, and it then appears that—even if the layer of water actually has the same depth under the whole level—drops will not be falling from the whole level at the same time although so much water is gathered that it must begin to fall.

The water will gather in drops, and then the surrounding water will make for the drops making them so big that they fall. If there are any unevenesses on the level, the drops will gather round these and be released from there.

We just turn this picture upside down replacing the level above us by the earth beneath us and the water with the ' pancake-thermals.' Presume that the heating of the sun makes the pancake so strong and thick as to force the air to leave the earth, the air like the water will then gather in a drop taking the pancake along from a certain area. In this way a horizontal current will be created along the earth. An uneveness on the earth similar to that under the ceiling will act like a releasing factor. This may be buildings, trees or the like. Now we have a rising mass of air with a horizontally moving part of the earth and then turn to the law of Corioli saying that a mass of air which is moving will try to reach the point of the earth which has a similar speed in proportion to axis. The earth turns from the west towards the east, and the air particle which lies at the equator moves with the speed of the surface of the earth at this place while the air particle which lies at the poles goes once around itself in one day and night. Between the poles and the equator there is a difference between the peripheral speed of the surface at each metre. The difference is greater at the poles and smaller at the equator.

If a power starts a mass of air from the equator towards the north pole, on its way it passes areas which have smaller speeds than its original speed, but as the air particle endeavours to keep its speed, it will—with the speed it possesses from the equator—run faster than the latitude which it crosses, i.e. in proportion to the surface of the earth this is a turning towards the east. The mass of air coming from the north pole towards the south will not be able to move with the increasing peripheral speed of the surface of the earth and so will be turned to the west.

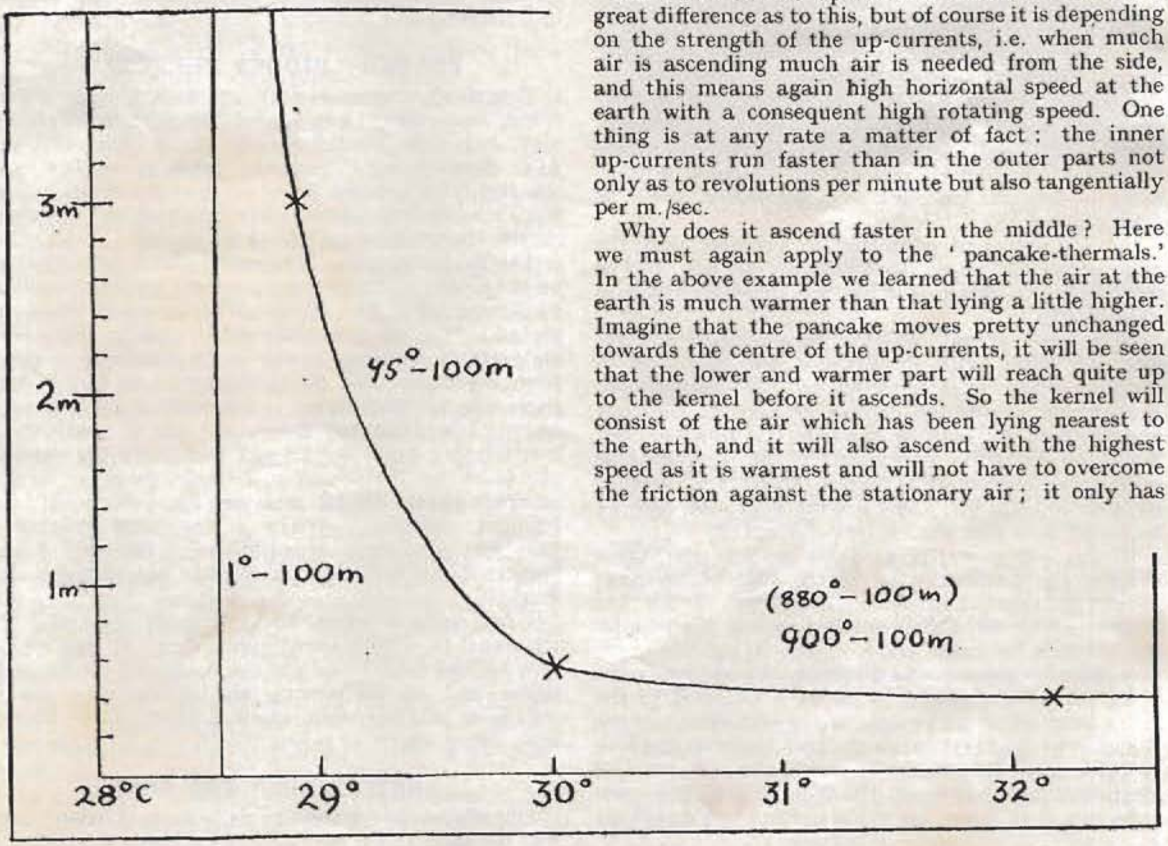
In all cases we have a power which turns the wind to the right when we stand with our backs to the wind, we will then let the 'pancake-thermals' release, and when ascending it will create a horizontal current at the surface of the earth. This horizontal current is subject to the law of Corioli to the effect that it will not move towards the centre of the ascending current, but will try to keep to the right of this. Now we turn our first experiment regarding formation of whirls in the water upside down and get the same result with the whirl, this time in the air. In case of calm weather, the pancake will soon be spent, but as it is seldom completely calm, the rotating pillar will move together with the surrounding air and thus take the pancake along as it proceeds. This is only an example. Of course there are innumerable variants as well as quite different systems of thermals, but this is probably the most common one.

The above is, however, if anything only a preface to the actual matter of question. Now we are going to use the rotation. A glider flying 60 km. per h. is able to fly a closed circle in 15 seconds—according to experience. In this time it flies 250 m. which, means a diameter of about 80 m., but as the diameter of the curve is depending on the speed in proportion to the earth, it will be able to fly its circles with a diameter of about 66 m. if the pillar of up-currents rotates with a speed of 10 km. per h. and if it flies towards the direction of rotation and with a rotating speed of about 20 km. in about 53 m. If on the other hand the glider flies in the direction of rotation the corresponding figures at 20 and 10 km./h. will be 93 and 106 m. in diameter.

From the above it will be seen that the circle diameter at the rotation of 20 km./h. will be about half as much when flying towards the rotation as when flying with it. Every glider knows what it means to be able to fly in small circles, especially in a low height where the thermals are narrow. Furthermore, the textbook says that the tangential speed in the whirlcase is inversely proportional to the distance from the axis to the effect that in fact there exists a possibility of diminishing one's curve diameter further beyond the above mentioned figures. This applies to low height. When ascending, the whirlcase—probably on account of the inner friction—will take the shape of a firm body where the speed is directly proportional to the distance from the axis.

How fast do the up-currents rotate? There is a great difference as to this, but of course it is depending on the strength of the up-currents, i.e. when much air is ascending much air is needed from the side, and this means again high horizontal speed at the earth with a consequent high rotating speed. One thing is at any rate a matter of fact: the inner up-currents run faster than in the outer parts not only as to revolutions per minute but also tangentially per m./sec.

Why does it ascend faster in the middle? Here we must again apply to the 'pancake-thermals.' In the above example we learned that the air at the earth is much warmer than that lying a little higher. Imagine that the pancake moves pretty unchanged towards the centre of the up-currents, it will be seen that the lower and warmer part will reach quite up to the kernel before it ascends. So the kernel will consist of the air which has been lying nearest to the earth, and it will also ascend with the highest speed as it is warmest and will not have to overcome the friction against the stationary air; it only has



the friction against an air which is already ascending a little.

How great is the up-current? It can almost be said that the size is depending not so much on the heating as on the earth it comes from. The rule must be that a level terrain involves great and rare up-current. If you imagine an infinitely large and level field, firstly no release will take place before the heat has become so strong as to make the release occur thermally, secondly the pancake will have free access to the up-current and support it for some length of time.

If we consider the opposite, e.g. a town, it will be seen that above this and in spite of the higher temperature in the streets than in the fields, there exists no regular up-current until towards evening; this is due to the fact that the pancake cannot float to the up-currents which start because the rows of houses impede free access, and when the up-currents have used the warm air that lay at the starting place, they will still be so small that they will quickly meddle in the above air. The fact that towards evening up-currents come from towns, woods, etc. is due to the following: The part of the atmosphere in which the up-currents have been working throughout the whole day has gradually changed the gradient of temperature from the original average of 0.75° per 100 m. to 1° per 100 m. simultaneously with the fact that at sunset these areas do not lose the warmth in direct radiation to the space as quickly as the level field.

The deflecting effect which is due to the power of Corioli is rather weak, and only in case no other factors assert themselves the up-currents will rotate to the left. But the releasing terrain hindrances may very well have such a shape and site as to give an impulse to a right rotation, and when the rotation is started it will build up itself and continue indifferently of the side (as long as a horizontal access is taking place).

We are therefore permitted to presume that the majority of the up-currents turn to the left, and so there is a reason for starting the thermals-flying in right curves.

It is, however, not so easy to ascertain whether you are flying with or towards the direction of rotation when once curving in the up-currents. Probably a stop-watch cannot be used to find out whether you fly with or towards the rotation, but it can no doubt be ascertained if the heeling angle is being examined at a certain speed and time of rotation in calm air. This heeling angle can now be measured as a thin line on the windscreen.

If you are now flying about in the up-current keeping the predetermined speed, time of rotations should be approximately constant, but if the line at the windscreen shows smaller incline than under the attempt in calm air, you are flying the right way, namely towards the direction of rotation.

An experiment might be to fix a G-meter to the instrument board and examine the deflections of the G-meter under certain speeds and times of curving in calm air. If you fly towards the direction of rotation in an up-current, the G-meter will show less deflection than if you are flying in the other direction.

Amen. Halleluja.

MY FIRST CROSS-COUNTRY

By J. H. C. BENNETT

IT was all thanks to the 'blow out' of the rear wheel of my motor-bike that I achieved my 'Silver C' height and distance! This may sound far-fetched, but I was stranded at Lasham and that is how I was available to make use of the right day.

The next morning, August 15th, 1951 my tyre arrived back, but as it was such a promising looking morning I hopefully D.I.'d the blue 'Grunau.' Then luck was on my side. An 'Auster' arrived, and John Free went over and organised a 'buckshee' aero-tow for me. At about 1.20 p.m. after Tony Deane Drummond had been aero-towed in the 'Olympia' and set off to Dunstable, I was airborne. It was very rough, with plenty of thermal activity —I used both hands on the stick on that tow! Thinking of 'Silver C' height I decided to release as early as possible.

At 1,600 ft. I was getting lifted well above the tug aircraft, so I released and very soon centred myself in a thermal of 4 ft./sec. up.

BRAVED 'HIDDEN HORRORS'

This slowly increased and very soon I realised that cloud base was getting close. I then decided that I must brave the hidden horrors of the cloud if I was to achieve 'Silver C' height. I then remembered all the terrifying articles I had read about cloud flying, but I managed to control these thoughts as I switched on the electric turn and bank indicator.

The gyroscope started to whine and I concentrated on my instruments to get the 'feel' before the cloud swallowed me. The mists slowly reached down to me and drew me into their white mantle. This was an exciting moment as the earth suddenly receded from my view. The lift increased to 10 ft./sec. but there was no turbulence and I maintained a steady circle. I had entered cloud at 4,600 ft. and now I was topping 5,000 ft. I felt I had had a big enough nibble at my first cloud so I straightened up on my compass course of 240° and very soon came out into brilliant sunshine. What a wonderful moment! This was a moment of achievement for me; I had traversed my first cloud and come out straight and level.

I had quite expected to have made my exit from the cloud in a high speed spiral dive. It was grand now to look round and see the fields and houses well below and be up among the clouds—the yellow cornfields of Hampshire made a pleasant patchwork with the green fields below.

CHRISTCHURCH THE GOAL

But there was no time to dally now—Christchurch was my goal and it was almost half-way through the afternoon. I pressed on at 50 m.p.h. and flew into three more clouds up to 5,000 ft. Then I saw that I had passed Southampton Water on my left and was just coming over the 31 mile limit. It felt fine to be crossing the 'Silver C' distance line with so much height in hand.

Turning my thoughts to 'Silver C' height it occurred to me that perhaps I had not quite got it 'in the bag.' From my release height of about 1,600 ft., 5,000 ft. gave only a very small margin so I determined to hang on longer next time.

INCIDENT WITH AIRLINER

I was now flying in a clear gap in the sky. Then I noticed a 'Dove' airliner coming almost directly towards me. He passed about 300 ft. below and to my left. I stared down at him and waggled my wings but he just cruised by indifferently as though he would not accept my presence, particularly as I was above him.

In front I now saw an active looking well developed cloud street. There was plenty of lift under it and once more I circled upwards at 5 ft./sec. increasing to 10 ft./sec. Cloud base remained at 4,600 ft. all the time.

20 FT./SEC. LIFT

This cloud was very active—inside the variometer registered to the top of the tube—at least 20 ft./sec. lift. There was some turbulence and things began to go wrong. The speed started to build up rapidly. I attempted to straighten up and rectify the airspeed and I pulled back on the stick. At 60 m.p.h. I continued to climb at 20 ft./sec.—I must have pulled on the throttle by mistake!

My one idea now was to get out of this cloud, but it was equally dark on all sides whichever way I tried to turn. I now noticed that, as well as having quite a high airspeed, the turn needle and ball were both hard over to the right. I applied opposite controls and generally did my best to rectify matters but nothing happened to ease the situation. I was getting a little worried—what a big cloud and there was no way out, except through the bottom perhaps! I must be cavorting along the length of the cloud street I thought. Then the earth appeared under my right ear and I quickly sorted myself out. It must have been a high speed spiral dive. At any rate I was relieved at having topped 5,400 ft. and clinched my 'Silver C' height, that is if the barograph had worked, and it had.

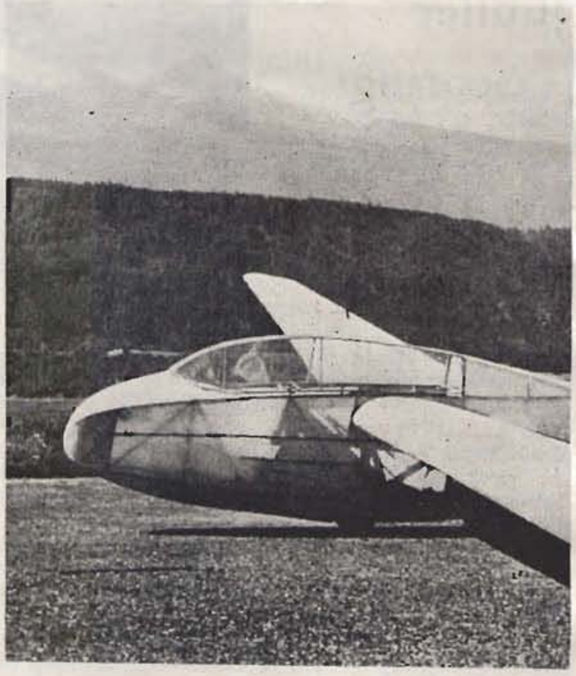
MADE FOR HURN

I got on to my course and relaxed again. I passed above Stoney Cross airfield and now decided to make for Hurn airport. Originally in this light N.E. wind I had decided to make for Christchurch but now I found I was rather to the north. Besides I was tired and my one idea was to make a respectable landing on a decent airfield. I made a wide circuit of Hurn airport at 2,000 ft. and studied the layout. Luckily I took notice of the wind sock which showed a southerly wind—I put this down to the 'sea breeze' effect.

At 4 p.m. I landed by the control tower on the grass, having covered 47 miles. There were four fire wagons at the ready if I needed them!

However I soon learnt that they were not for me and I felt very small when soon afterwards the new 'Valiant' bomber came roaring in along the main runway.

High Performance Two-Seater Mü-13 E 'Bergfalke'



Mü-13 E 'Bergfalke'

DESIGNER of the two-seater trainer and high performance sailplane Mü-13 E 'Bergfalke' was Egon Scheibe, Munich, who made use of the experience gained from the designs of the 'Milan' and 'Mü-13 D.' Professor Krauss, Augsburn, took an essential part in the stress calculations.

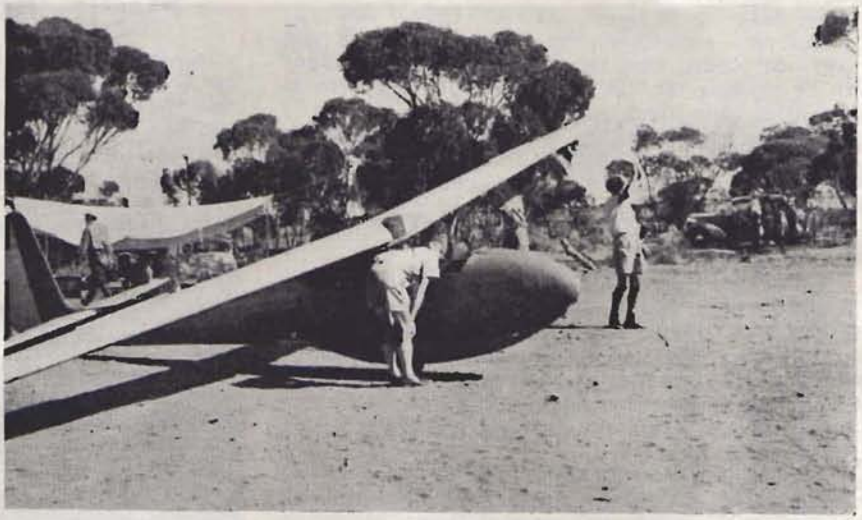
The prototype was built by the gliding club at Jenbach/Tyrol under the supervision of Dr. Konschegg, who also piloted the sailplane on its maiden flight. A winch-launch was used at Innsbruck on August 5th, and favourable impressions regarding handling properties as well as performance were created.

Simple to handle, the aircraft retains the viceless stall of its predecessors. The aileron drag of the

(Continued on page 260)

South Australians Jubilee Soaring Contests

By
BRIAN P. CREER



This Report of the Contests held at Waikerie over Easter only arrived at ' Sailplane ' office a few days ago having been in the post for nearly eight months ! In order that this activity of our antipodean friends shall not go unrecorded, Brian Creer's report is published but largely condensed.

1951 being Australia's Jubilee year, Easter holiday week-end saw the S.A. Gliding Association's Jubilee soaring contest. The place was easily decided upon—Waikerie.

The Association invited all states to take part, but, unfortunately, distance prevented this, but we did have a representative from New South Wales and several from Victoria.

Various difficulties prevented the Victorian Motorless Flight Group from taking part but, a group of their members and a privately-owned machine represented them.

The ' H-17,' although owned by the Waikerie Club was loaned to Alan Ash of the Hinkler Club, Sydney, Nance Iggulden of the V.M.F.G. and myself for use in the contests. Aircraft were in two performance classes.

Class I consisted of the two ' Olympias,' the ' Blue Gull ' and the ' Kite II,' whilst Class II included the two ' Grunau's,' the ' Kestrel ' and the ' H-17.'

PRACTICE DAY

Friday was a practice day and all launching was by winch. Total time for the day was more than 34½ hours for the eight aircraft and between them they had climbed 44,500 ft.

Saturday was one of those days when the thermals were good if you could work your way above about 2,500 ft. Some pilots were unlucky and just couldn't make that vital thousand feet above launching height.

Top: John Wotherspoon's Blue Eon ' Olympia ' ' Colombus II ' waits in the line for take-off time in the Contests at Waikerie.

Left: Jonas Parygius (in cap at nose), gives Alan Delaine a last minute briefing as he prepares to take-off in the Adelaide Soaring Club's Blue ' Gull I.' Note redesigned nose and canopy.

These photos by Brian Creer, are part of his movie coverage of the meet that he filmed. These still prints are from movie shots taken at 16 frames per sec. at F.8 or F.11-F.16.

COMPETING AIRCRAFT.

Aircraft.	*Club.*	*Pilots.*
'Blue Olympia'	Private	J. Wotherspoon, 'Jock' Barrett
'Yellow Olympia'	Waikerie G.C.	L. Brown, R. S. Rowe
'Blue Gull I'	Adelaide S.C.	J. Pyragius, C. Tolhurst, A. Delaine
'Grunau Baby IIb'	Waikerie G.C.	H. G. Donaldson, C. Heidrick
'Golden Grunau Baby IIb'	Adelaide S.C.	I. Wyatt, P. Killmier, B. Creer, C. Schwartzcoppf
'Kite II'	Waikerie G.C.	C. Buckley, E. Diecmanis
'Kestrel'	Private	W. P. Iggulden, J. Iggulden W. A. Iggulden
'Hutter H-17'	Waikerie G.C.	A. Ash (N.S.W.), Nance Iggulden (Vic.), B. Creer (S.A.)

None the less John Wotherspoon kept the 'Olympia' in the air for 4 hours 20 mins. and managed 5,000 ft., Ted Deicmanis soared the 'Kite' to the same height for 2 hours 38 mins. Alan Delaine bettered this height by 200 ft. for 2 hours 32 mins. in the 'Blue Gull' and I managed to tag him for 2 hours 10 mins. during which time I just topped 5,700 ft.

Wotherspoon also held the 'Olympia' up for 57 mins. later in the day. The 'H-17' was out of luck and could just scrape over the minimum time to record 11 mins.

This was the first really good get-together of Australian gliding types from three states and we made the most of it. We in Australia are greatly handicapped when it comes to meeting fellow glider pilots because of the great distances separating each state band. But we are a close-knit bunch for all that.

SUNDAY WAS A BAD DAY

Sunday was a bad day from the start to the finish as far as thermals were concerned and it looked as if we had said goodbye to the good weather. Les Brown in the 'Yellow Olympia' put up the best time of the day with 1 hour 35 mins. to 5,500 ft.

All the other machines tried but could only obtain 15 and 19 minute fumbles.

I had my first and, as yet, only flight in the 'H-17' and rather enjoyed the stiff high speed feeling of the little machine. However a poor launch to only 450 ft. gave me little chance to see what the tiny ship would do and although I struck a beauty at about 200 ft. I gave it away. Had I been in the 'Grunau' I may have tried, but not in a strange kite.

Sunday night we held a competitors' meeting and decided that as Sunday's weather had been such a flop and Friday's so good we would count points for all flights over ten minutes made on Friday.

Monday came and although the competitions were still in full swing due to Sunday's bad weather the two 'Grunaus' and the 'H-17' were not flown. This was because we Adelaide blokes wanted to get the 'Golden Grunau' packed up early in the afternoon after packing up camp in the morning. We did, however, fly the 'Gull.'

Les Brown in the 'Yellow Witch Olympia' had disappeared somewhere just before John Wotherspoon's 'Blue Olympia' was whisked off 40 miles for 2 hours 30 mins. to a height of 7,000 by Jock Barrett.

The night came and we were in various retrieving crews bringing in the 'Blue Olympia' and the 'Kite II' and still there was no news from Les Brown.

Then it spread around the camp like fire. Les had reached Oyen in Victoria, 140 miles away after a 4 hour 30 minute flight during which time he gained an altitude of 9,600 ft.

That was the flight needed to cap off a wonderful week-end and everyone was pleased to see such a flight go to such a popular guy as Les.

The contest was over and everyone had had a swell time.

PERFORMANCES

Distance: Les Brown, 'Yellow Witch,' 140 miles.

Height: J. Parygius, 'Blue Gull,' 6,200 ft. (official); Les Brown, 'Yellow Witch,' 9,600 ft. (un-official).

Duration: R. Rowe, 'Yellow Witch,' 6 hours 14 minutes.

The points were shown in three groups; individual, aircraft, and state as follows :—

Individual Points: Les Brown 202, 'Jock' Barrett 103, J. Wotherspoon 100, B. P. Creer 93, C. Buckley 81, J. Pyragius 80½, R. S. Rowe 76, H. G. Donaldson 75, W. P. Iggulden 39, A. Ash 36, J. Iggulden 28, C. Tolhurst 15½, C. Heidrick 4.

Positions of Aircraft: 'Yellow Witch Olympia' (W.G.C.) 278, 'Blue Olympia' (Private) 190½, 'Gull' (A.S.C.) 162½, 'Kite II' 141½, 'Golden Grunau' 93, 'Grunau' (Waikerie) 79, 'Kestrel' 67, 'H-17' 36.

State and Team Positions: South Australia: Waikerie Gliding Club—689 points, Adelaide Soaring Club—255 points=944 points.

Victoria: Victorian Motorless Flight Group (represented)—67 points.

New South Wales: Hinkler Soaring Club (represented)—36 points.

Due to the success of this meeting the Gliding Federation of Australia is to hold the first Australian National Gliding Contests this Christmas.

However, because of the distance problem, these Nationals will be held on an intra-state basis. Each state will conduct its own competitions individually.

NEW 'SAILPLANE' OFFICES

'SAILPLANE' has now moved its Editorial and Advertising Offices from The Strand to **8, LOWER BELGRAVE STREET, VICTORIA, S.W.1. (Telephone: SLO 4823)**, to which *all* correspondence should now be addressed.

THE EDITOR offers his personal apologies to F/L A. W. Bedford for the misunderstanding which resulted in his being stated to have joined the De Havilland Company when in fact he is Test Pilot for the Hawker Group. Nor did he crash as we reported when he force-landed his undamaged 'Olympia' at Woking.

THE ENGAGEMENT is announced between Arthur Louis Lionel, elder son of the late Mr. A. Alexander, and of Mrs. Alexander of Baron's Court, Bishop's Avenue, London, N.2, and Barbara Elizabeth Ramsay, daughter of Mr. and Mrs. E. Ramsay Green, of 3, Crescent Mansions, Chelsea.

'Lionel,' a member of the Cambridge University Gliding Club, was awarded the Brunt Trophy in March. He was also *Sailplane's* Editor for the later part of last year.

A refinement of the Pulse Reactor S. N. E. C. M. A. ' Escopette ' installed in the ' Emouchet ' (French ' Grunau Baby '), which was the first self-contained propellent in the world. Attached to the glider is a group of three Jet units on either wing. Photo taken at Paris Show by ' Alata '

TWO-SEATER MÜ-13 E 'BERGFALKE'

(continued from page 257)

' Mü-13 D ' has been minimized by several measuies, and the flights showed that there are no major modifications necessary with respect to handling properties, control effects, etc.

C. OF G. AND NOSE HOOK

For winding the aircraft is equipped with a nose-hook as well as a centre-of-gravity hook on one side of the skid. A fixed wheel has been fitted to the fuselage in front of the centre of gravity in order to shorten the take-off run and facilitate retrieving on the ground. The landing is easy ; the glide can be controlled by means of spoilers which are shaped and arranged like those of the ' Mü-13 D,' A normal landing can be carried out on the wheel.

Visibility from both seats is very good and the two cockpits are covered by the same hood which opens sideways. The pilots sit very close to each other, which makes communication very easy. The rear seat is almost in the centre of gravity so that the trim of the aircraft is not affected by the weight of the second pilot.

Special allowance has been made for easy rigging. The wings which are attached to the sides of the fuselage without separate fairings can be put on or taken off in a few seconds. There are no loose pins.

STEEL CONSTRUCTION

The approved steel construction has been used for the fuselage, the main material being standard steel precision tubing. The rectangular framework changes into a triangular shape towards the tail. Three wooden longerons help to streamline the structure. The tail-skid is rubber-sprung, and there is a sprung fairing at the bottom of the fuselage behind the landing wheel.

Wings are of the cantilever, single-spar type with a torsion-nose. The flanges of the I-spars are made of laminated beach which has a great and uniform strength. Simple, wooden spoilers turn about an axle in the wing, and steel *(Continued on page 263)*

DYNAMIC SOARING—*(continued from page 250)*

air-speed is meant here, so do not let us get the idea that an aircraft can develop a higher ground-speed flying upwind than going down-wind owing to the dynamic effect.

The second kind of dynamic soaring, the use of gust energy in straight flight has a parallel in man-powered flight where our present knowledge and the possibility of its realization are concerned. According to theory, an aircraft travelling at medium speed gains more kinetic energy from a gust of +2 m./sec. than it loses on hitting a gust of the same magnitude but of opposite direction. It is most likely that the sum of all gusts with respect to direction and amplitude equals zero taken over a certain time.

If we therefore assume that on an average there is the same number of gusts of the same size in one direction as there is in the opposite direction, we can conclude that there is certainly a gain of energy. It is comparatively easy to calculate what frequency of a certain amplitude of gust per minute is required to enable a modern sailplane to soar.

The actual meteorological observations differ widely. A few meteorologists who are not so well-known recorded gust conditions where a wind of 8 m./sec. mean velocity fluctuated between 4 m./sec. and 12 m./sec. four times per minute. Professor Idrac measured considerably smaller fluctuations of ±0.5 m./sec. over water. The actual values which we are likely to find in most cases will lie between those figures.

What conditions are required for dynamic soaring ?

Let us take one of our high performance sailplanes with a sinking speed of 0.6 m./sec., i.e. an aircraft which loses 36 m. per minute. The corresponding airspeed is 15 m./sec. The following gain of height occurs when a gust of +2 m./sec. passes through, followed by a gust of −2 m./sec.

The increase of the kinetic energy of the sailplane relative to the air on the setting in of the gust is to be converted into height as the gust is passing through. According to the Principle of Conservation of Energy the kinetic energy equals the potential energy :—

$$\frac{mv^2}{2} = mgh$$

Our gain of height is given by :—

$$\Delta h_1 = \frac{(v + \Delta v)^2 - v^2}{2g}$$

$$= \frac{17^2 - 15^2}{20} = \frac{289 - 225}{20} = 3.2 \text{ m.}$$

Hence the loss of height on passing through of the negative gust of -2 m./sec. is :—

$$\Delta h_2 = \frac{v^2 - (v - \Delta v)^2}{2g}$$

$$= \frac{225 - 169}{20} = 2.8 \text{ m.}$$

The total gain of height after a complete gust oscillation is therefore :—

$$\Delta h_1 - \Delta h_2 = 0.4 \text{ m.}$$

In order to make up for the normal sink of the sailplane $36/0.4 = 90$ gusts are required per minute. The natural frequency is much less, 5 per minute on an average. This means that 2 metres are gained per minute with 5 gusts of ± 2 m./sec., compared with the normal sink of 36 metres. This difference is beyond the accuracy of our variometers. The energy is also insufficient for a bird to soar. Although the limits are higher with abnormally strong gusts, it will not be enough.

Many inventors are trying to find means to make better use of gusts, e.g. increasing the angle of attack or changing the camber of the section on the setting in of the gust. We can make the following comment on this :—

The best sink of a sailplane is found with a lift coefficient $c_L = 1$ (approx.). The sinking speed is practically constant for values of $C_L = 1 \pm 5\%$. The setting in of a horizontal gust of 2 m./sec. causes a decrease of the angle of attack and thus a drop of the lift coefficient by 2%. The effect of the rise in speed is what matters ; it causes the gain of energy in spite of the smaller lift coefficient, but always within the range of the c_L for the best sink. Why then increase the angle of attack which, in any case, spoils the sinking speed and thus the effect of the gust ?

The answer is to freeze the stick in gusty conditions, not only for reasons of handling, but also for reasons of performance, as can be shown. This will result in the relatively greatest improvement of performance. Dynamic soaring in straight flight, by letting the atmosphere do all the work, will remain a dream.

Translation from 'Thermik,' Jan./Feb., 1951.
By G. S. NEUMANN.

GLIDING IN ARGENTINE—*continued from page 253.*

Merlo since June, 1949 and is supposed to be converted into a powered sailplane later on. Some of its data are :—Span 18 m., gliding angle 1 in 28.5 at 75 km./h. (= 47 m.p.h.), weight loaded 475 kg.

Adriano Mantelli designed several ultra-light aircraft. For experimental purposes he built a powered sailplane, the ' A.M.-11,' details of which appeared in the June issue). Mantelli advocates the introduction of a new type of training based on the powered two-seater sailplane with side-by-side seating.

GREAT SIGNIFICANCE

The formation of this research institute is of the greatest significance not only for the Argentine, but also for the world gliding movement, as with this step the Argentine seizes an important position in the international gliding world. The programme of studies includes the development of new high-performance sailplanes, research on new landing and training methods, and meteorological observations of the lee-waves set up by the Andes.

The first repercussion of the development of gliding in the Argentine on world gliding was the offer to organize the International Contest, 1952, which was received by the F.A.I. along with the applications by England, France, the United States, and Spain. The Argentine was even prepared to meet all expenses of the visiting teams.

Condensed from 'AERO'

' Horten XV '

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SALES DATA

Item No.	Description	Crate Measurement	Total Weight	Cubic Capacity	Ex-Works Cost	Crated for Export
1.	' Cadet ' (Full Kit Form) ..	19' 6" × 2' 3½" × 1' 1"	5 cwts. 90 lbs.	49.1	£246	£262
2.	' Cadet ' (Completely made) ..	19' 5" × 3' 8" × 4' 10½"	11 cwts. 1 lb.	315.885	£392	£437
3.	' Tutor ' (Full Kit Form) ..	21' 11" × 2' 3½" × 1' 1"	6 cwts. 90 lbs.	55.5	£291	£307
4.	' Tutor ' (Complete)	22' ½" × 3' 8" × 4' 11"	12 cwts. 28 lbs.	392.5	£442	£487
5.	Type ' 21-B ' (Full Kit) ..	27' 1" × 4' 1" × 10"	11 cwts. 85 lbs.	91.72	£613	£646
6.	Type '21-B' (Completely made)	27' 4" × 6' 0" × 5' 4"	19 cwts. 47 lbs.	874.0	£905	£975
7.	' Prefect ' (Full Kit)	23' 0" × 2' 3½" × 1' 1"	6 cwts. 90 lbs.	56.0	£389	£408
8.	' Prefect ' (Complete)	23' 0" × 3' 6" × 4' 6"	12 cwts. 28 lbs.	362.0	£602	£647
9.	' Gull IV ' (Completely made)	25' 2" × 4' 8" × 3' 4"	13 cwts. 77 lbs.	390.4	£1,100	£1,139
10.	' T.31 ' dual, ' Tandem Tutor '	22' 0" × 4' 6" × 5' 0"	12 cwts. 34 lbs.	495.0	£505	£554
11.	' T.31 ' dual, ' Tandem Tutor ' (Full Kit)	22' 0" × 2' 7" × 11"	7 cwts. 56 lbs.	55.0	£329	£345
12.	' Sky ' (Completely made) ..	30' 2" × 4' 8" × 3' 4"			£1,100	£1,149

INSTRUMENTS EXTRA

Pullin Electrical T. & B.	£18. 10s. 0d.
A.S.I. by K.D.G.	9. 0s. 0d.
Ex-R.A.F. Altimeter (new)	5. 0s. 0d. (R.A.F. limited supply).
Cobb-Slater Variometer	7. 13s. 8d.

TWO-SEATER MÜ-13 E 'BERGFALKE'

—contd. from page 260

tubing has been used for the ailerons which gives them greater rigidity.

PLACING THE SECOND PILOT

Since the leading edge of the wings is straight, we obtain a slight negative V-shape on the whole. At the wing root a steel framework transmits the forces from the main-spar 26 cm. back to the joint where they are taken up by the fuselage. This arrangement, together with the negative V-shape, makes it possible to place the second pilot in the centre of gravity, where he has good visibility favoured by the mid-wing design. In addition to the main-spar joint the wings are connected with the fuselage by means of front spar fittings.

The rear stick of the dual control system can be taken out. The elevator and ailerons are moved by push-rods, the rudder by cables. Both rudder and elevator are balanced. The fin is firmly attached to the fuselage and can be built of either wood or steel.

Data :—

Span	56 ft.
Length	26 ft.
Wing area ..	200 sq. ft.
Aspect ratio ..	15.9
Weight empty ..	485 lb.
Weight loaded ..	880 lb.
Wing loading :	
flown solo ..	3.4 lb./sq. ft.
flown as a two-seater ..	4.4 lb./sq. ft.
Minimum sinking speed :	
flown solo ..	2.2 ft./sec.
flown as a two-seater ..	2.5 ft./sec.
Best gliding angle	1 in 26
Stalling speed ..	32 m.p.h.

ROYAL AERO CLUB CERTIFICATES

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

CERTIFICATES 'A'	..	184 (13705 to 13888 inclusive)
'B'	..	133
'C'	..	33
Silver 'C'		5
Gold 'C'		—

'B' CERTIFICATES

No.	Name	A.T.C. School or Gliding Club.	Date taken
4497	Donald H. Chappell	Bristol G.C.	7. 9.51
6291	Michael C. Fairman	Surrey G.C.	6. 7.51
6756	David J. Dennis	Bristol G.C.	7. 9.51
9213	Alan M. Johnson	No. 82 G.S.	19. 8.51
9907	Charles J. Beanland	No. 130 G.S.	2. 9.51
9913	Wilfred A. Elders	No. 122 G.S.	13. 8.51
9986	David N. Jones	Home Command	5. 9.51
10356	Ian Easson	No. 5 G.S.	26. 8.51
10477	Edwin G. Wilkinson	S.G.U.	23. 8.51
11284	Martin J. Jevans	No. 24 G.S	29. 8.51
11423	Richard W. Harris	No. 168 G.S.	6. 4.51
11697	Gordon R. Lowe	No. 49 G.S	15.10.50
11891	Derek V. Reypert	Cranwell	23. 6.51
12251	Derek Kenyon	No. 24 G.S.	4. 3.51
12445	John H. S. Hall	R.N.G.S.A.	29. 8.51
12476	John A. Trevillion	R.N.G.S.A.	3. 9.51
12479	Alan Clayton	No. 24 G.S.	2 9 51
12504	Cyril L. Smith	R.N.G.S.A	4. 9.51
12589	Samuel S. Faulkner	R.N.G.S.A.	28. 8.51
12818	Norman C. Shippey	No. 105 G.S.	8. 9.51
12901	Robert M. Musgrave	No. 122 G.S.	17. 8.51
13905	James D. Spottiswood	No. 31 G.S.	1. 6.51
13124	David R. Hodgson	No. 104 G.S.	2. 9.51
13170	Anthony S. Barmby	No. 23 G.S.	16. 9.51
13223	Gordon G. Drennan	No. 183 G.S.	5. 8.51
13304	John Akin	No. 130 G.S.	2. 9.51
13422	James S. Phillips	Bristol G.C.	12. 9.51
13437	John F. Crowe	Halton Apps.	9. 9.51
13446	Douglas G. Prescott	No. 186 G.S.	2. 9.51
13456	David Mitchell	No. 23 G.S.	9. 9.51
13521	John Bate	No. 186 G.S.	23. 9.51
13610	William B. G. Hopkins	No. 123 G.S.	2. 9.51
13617	Alexander J. Black	No. 105 G.S.	9. 9.51
13693	Thomas Fraser	Aberdeen G.C.	9. 9.51
13695	Grace C. King	Aberdeen G.C.	9. 9.51
13706	Michael C. Costin	London G.C.	25. 9.49
13707	Alan D. Cooper	Dartmouth G.C.	29. 8.51
13708	William M. Forbes	R.N.G.S.A.	28. 8.51
13709	George A. Hall	R.N.G.S.A.	28. 8.51
13710	Peter S. Jackson	R.N.G.S.A.	29. 8.51
13711	Roger H. M. R-Bunbury	R.N.G.S.A.	29. 8.51
13712	Richard M. S. D. Hutchinson	R.N.G.S.A.	29. 8.51
13713	David G. S. Waterstone	No. 168 G.S.	28. 8.51
13715	Robert J. Calder	No. 168 G.S.	29. 7.51
13716	Charles Davidson	Aberdeen G.C.	26. 8.51
13717	Paul G. Gooding	No. 168 G.S.	24. 6.51
13718	Robert C. M. Hobday	Dartmouth G.S.	20. 8.51
13719	Geoffrey L. Shaw	Dartmouth G.S.	20. 8.51
13720	Desmond Slinn	No. 45 G.S.	8. 7.51
13728	Ronald J. Arbon	London G.C.	3. 6.51
13729	Michael C. Fox	Dartmouth Cadet C.G.	20. 8.51
13733	Peter J. Leveridge	No. 168 G.S.	30. 8.51
13738	Wilfred H. Sear	E.T.P.S.	14. 7.51
13739	Joseph Hossack	No. 5 G.S.	24. 7.51
13740	David C. Hough	No. 64 G.S.	2. 9.51
13741	John S. Swanson	Surrey G.C.	9. 8.51
13742	Roy Tweats	No. 45 G.S.	29. 7.51
13752	Nicholea Walker	No. 92 G.S.	3. 6.51
13753	Ralph H. Robins	No. 64 G.S.	21. 8.51
13754	John M. T. Hilton	Dartmouth Cadet G.C.	20. 8.51
13755	Peter D. Smith	Bristol G.C.	1. 8.51
13757	Stanley H. Guy	Derby & Lancs.	18. 7.48
13761	Carl Agostini	Midland G.C.	3. 9.51
13762	Clive E. Elton	No. 168 G.S.	19. 8.51
13766	Peter J. Walker	No. 42 G.S.	15. 7.51
13767	John I. Langford	No. 42 G.S.	8. 7.51
13768	George A. Brice	No. 42 G.S.	22. 7.51
13769	Michael J. Brett	No. 42 G.S.	8. 7.51
13770	Roland C. Summers	No. 42 G.S.	22. 7.51
13771	Michael J. McEwan	No. 42 G.S.	15. 7.51
13772	Alfred E. Sadler	B.A.F.O.	6. 5.51
13773	James M. Morrey	No. 5 G.S.	23. 8.51
13774	Brian F. King	Dartmouth Cadet G.C.	20. 8.51
13775	Francis P. D. Miller	R.N.G.S.A.	4. 9.51
13776	Reginald P. D. Sands	Home Command	7. 9.51
13777	John H. Camp	Dartmouth Cadet G.C.	20. 8.51
13780	Malcolm J. Moore	No. 125 G.S.	2. 9.51
13785	Robert T. Coker	Home Command	7. 9.51
13786	Albert J. Merritt	Home Command	7. 9.51
13787	Brian R. F. Osman	No. 168 G.S.	10. 8.51
13788	Denis W. Gibbs	No. 89 G.S.	8. 8.51
13789	Trevor Pack	Home Command	9. 9.51
13790	John D. Pugh	No. 168 G.S.	19. 8.51
13795	Michael F. Smith	No. 146 G.S.	2. 9.51
13796	Ian M. Waller	Home Command	5. 9.51
13797	Graham H. Bridger	R.N.G.S.A.	28. 8.51
13798	William A. S. Murray	S.G.U.	7. 9.51
13801	Robert C. Addis	R.N.G.S.A.	9. 9.51
13802	Arthur F. Brown	R.N.G.S.A.	10. 9.51

'B' CERTIFICATES (cont.)

No.	Name	A.T.C. School or Gliding Club.	Date taken
13803	John S. King	R.N.G.S.A.	1. 7.51
13804	Robert L. McRae	No. 44 G.S.	9. 9.51
13805	John A. Edwards	S.G.U.	7. 9.51
13806	John Sullivan	S.G.U.	7. 9.51
13807	James E. Thomsett	Home Command	7. 9.51
13808	Arthur T. E. Withers	No. 122 G.S.	9. 9.51
13809	Albert Barnhurst	No. 125 G.S.	2. 9.51
13811	Kenneth Parker	Home Command	7. 9.51
13812	Adrian Wright	No. 166 G.S.	16. 8.51
13815	Peter B. Godley	R.N.G.S.A.	10. 9.51
13816	Roger M. Goss	No. 168 G.S.	19. 8.51
13817	John C. M. Shepherd	Bristol G.C.	5. 9.51
13818	Neale G. Warnford	R.N.G.S.A.	10. 9.51
13819	Stanley J. Nettle	B.A.F.O.	13. 5.51
13825	Owen D. Goddard	R.N.G.S.A.	10. 9.51
13826	Marcus H. Hoare	Culham G.C.	10. 9.51
13827	James C. Vinall	No. 168 G.S.	29. 7.51
13832	Denis H. Bryce	S.G.U.	25. 8.51
13833	Malcolm E. Clarke	Bristol G.C.	30. 6.51
13834	Peter W. Locke	R.N.G.S.A.	24. 5.51
13835	Royston G. Wiltshire	Home Command	7. 9.51
13845	Peter H. G. Newhouse	B.A.F.O.	21. 5.50
13847	Arthur C. Mawson	No. 64 G.S.	15. 8.51
13848	Tom Laidler	Home Command	6. 9.51
13849	Thomas A. R. Scott	B.A.F.O.	1. 7.51
13852	Colin G. Bell	No. 168 G.S.	19. 8.51
13853	John P. Brennan	B.A.F.O.	15. 8.50
13854	William Aldock	No. 168 G.S.	15. 7.51
13855	John W. Crawford	S.G.U.	7. 9.51
13856	Walter W. T. Moore	No. 82 G.S.	23. 8.51
13861	Allan G. Tripp	No. 123 G.S.	22. 9.51
13864	Michael Chalcraft	No. 168 G.S.	17. 8.51
13865	Christopher D. Duthy-James	Cambridge Univ. G.C.	22. 9.51
13866	Ian G. Elliott	No. 168 G.S.	15. 4.51
13868	Brian L. Cave	R.E. G.C.	22. 9.51
13869	Michael R. Harding	No. 168 G.S.	19. 8.51
13870	Michael C. McCallum	No. 168 G.S.	19. 8.51
13876	Roger H. Ellis	No. 168 G.S.	18. 8.51
13877	Arthur J. Whitworth	No. 42 G.S.	6. 8.51
13880	Michael F. Seal	No. 168 G.S.	16. 9.51
13881	John R. Nicholls	No. 166 G.S.	17. 8.51
13882	Christopher C. Wood	R.A.F. College	15. 7.51
13884	Norman J. Down	No. 168 G.S.	19. 6.51
13887	John Severn	Cranwell	16. 9.51

'C' CERTIFICATES

No.	Name	A.T.C. School or Gliding Club.	Date taken
2694	William L. Grey	Home Command	31. 8.51
6942	Stephen O. G. Willson	No. 44 G.S.	2. 9.51
8808	Kenneth N. Harris	Home Command	15. 8.51
10193	Thomas W. Whitworth	No. 64 G.S.	22. 8.51
10592	Victor S. Bailey	No. 125 G.S.	2. 6.51
10700	Peter J. Brown	A.T.C. Camphill	5. 8.51
12064	George A. Coatesworth	Cranwell	11. 8.51
12308	Roy Poulter	No. 23 G.S.	3. 9.51
12339	Derrick G. W. Eeles	No. 106 G.S.	21. 9.51
12373	George E. Simpkin	No. 64 G.S.	15. 8.51
12419	John J. Mawson	No. 23 G.S.	19. 8.51
12495	Michael C. Whitworth	No. 64 G.S.	19. 8.51
12583	Xenia Ancrum	B.A.F.O.	9. 9.51
12842	Geoffrey G. Fish	No. 125 G.S.	26. 8.51
12868	Thomas Ian Samuel	No. 125 G.S.	26. 8.51
12948	Derek E. Renshaw	Cranwell	10. 8.51
13070	Lionel F. Coulshaw	R.N.G.S.A.	14. 7.51
13118	James P. Dainty	R.A.E. Tech.	10. 8.51
13152	Rowland Burton	No. 22 G.S.	15. 8.51
13297	Jack L. Bayley	Cranwell	10. 8.51
13332	Arthur H. Tobin	R.N.G.S.A.	23. 9.51
13391	Iavin H. Payne	No. 104 G.S.	19. 8.51
13415	John E. G. Harwood	B.A.F.O.	6. 8.51
13706	Michael C. Costin	London G.C.	20. 2.50
13728	Ronald J. Arbon	London G.C.	17. 6.51
13738	Wilfred H. Sear	E.T.P.S.	18. 7.51
13753	Ralph H. Robins	No. 64 G.S.	22. 8.51
13772	Alfred E. Sadler	B.A.F.O.	10. 6.51
13803	John S. King	R.N.G.S.A.	3. 4.51
13819	Stanley J. Nettle	B.A.F.O.	2. 9.51
13845	Peter H. G. Newhouse	B.A.F.O.	1. 7.50
13849	Thomas A. R. Scott	B.A.F.O.	8. 7.51
13853	John P. Brennan	B.A.F.O.	28. 3.51

SILVER 'C'

No.	Name	A.T.C. School or Gliding Club.	Date taken
353	J. J. Parker	Cranwell	27. 8.51
354	W. H. Sear	E.T.P.S.	29. 8.51
355	D. J. Edwards	Cranwell	27. 8.51
356	J. P. Brennan	B.A.F.O.	6. 8.51
357	S. D. Ryall	No. 62 Group R.A.F.	16. 6.51