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RHÖN SOARING FLIGHT COMPETITION, 1921.

By Wilhelm Hoff.

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LECTURE ON THE RHÖN SOARING FLIGHT COMPETITION, 1921*

By Wilhelm Hoff.

Eleven days ago, on August 25th, the Rhön Soaring Flight Competition of 1921, which was held on the Wasserkuppe, came to an end. Three flights of over five minutes' duration, six flights over a distance of more than 1 1/2 kilometers up to 3.9 kilometers, four circular flights, and about 120 competitive flights, mark the advance over the performances of the previous year when Klemperer on the "Black Devil" of the Aachen Flugwissenschaftlichen Vereinigung made a flight of 1.83 kilometers in 2 min. 22.4 sec., this being the best performance of that year and one which served as an encouragement for this year's meeting.

Scarcely had these records been established when they were broken by Klemperer. Starting from the western slope of the Wasserkuppe, he succeeded in flying over several places, keeping in the air for about 13 minutes, ten of which were taken up by a soaring flight, and reached the outskirts of Gersfeld. Measured in a straight line, the flight covered a distance of 4 kilometers. The difference of altitude between the starting and landing points was 378 meters.

To me has fallen the honor of presenting an address on the Rhön Competition, and I do so gladly, since I was there the whole time, though not as a practical aviator - simply forming one of the family temporarily installed on the mountainside and taking part in the preparations for the event. Since the eventful closing day on August 25th, the time has been too short for us to be able to judge the data properly, and I would therefore beg you to excuse me if I base my report on my direct personal observation.

At the Sixth General Meeting of the WGL in October of last year, it was decided that the objects of the German Modell und Gleitflugverein, directed with so much energy and zeal by Civil Engineer Oskar Ursinus of Frankfort-au-Main, should also be taken up further by the WGL. Since our Society must have nothing to do directly with sporting, competitive flights, we were not able to take the lead in the arrangements. The South-West Group of the German Luftfahrer Verband therefore undertook, in the most praiseworthy way, to come to the rescue and arrange the Rhön Soaring Competition of 1921, in conjunction with the young German Modell und Gleitflugverein, which was not strong enough to grapple alone with the undertaking.

The South-West Group succeeded in arranging the meeting to the satisfaction of all those who took part in it, and may well be

* Translated from an advance proof supplied by Dr. Hoff.

proud of the success of the Competition.

The Wissenschaftliche Gesellschaft für Luftfahrt assumed the honorary presidency of the venture. Several meetings were held in Augsburg, Frankfort, Berlin and Munich to discuss and draw up the rules and regulations of the Competition. These meetings were attended by representatives of the WGL who took an eager interest in the proceedings. The WGL also aroused the interest of many important public bodies in the new form of aviation and secured their support. That this year's competition could be arranged on a larger scale, was due to the influence of the WGL as well as to the active propaganda work of the Frankfort people.

The question has arisen why the WGL has placed the whole weight of its authority behind a competitive aerial event. Allow me to say a few words in answer to this question.

Hitherto, flight has only been possible through a source of power carried on the airplane. The natural energy inherent in the wind was left unemployed and was even found to be a hindrance when coming in a sudden squall. The pioneers of soaring flight have set themselves the task of making it possible to utilize the source of energy found in the wind. We can distinguish two kinds of such energy: the upward current and the fluctuations of the wind in force and direction. Of these two kinds, the upward current as it rises in hilly countries is the most important, and the conditions are particularly favorable in the Rhön district with its detached gently-sloping hills. To firm adherents of soaring flight, the upward current is not the ideal source of energy; on the contrary, they seek to utilize the fluctuations of the wind.

How this can be done was shown by Betz in 1912* and also more recently by Prandtl** and von Karman***. Ahlborn, of Hamburg**** has written a detailed report on soaring flight based on his observations of the flight of birds and on the flight of motorless aircraft. Certain possibilities of flight without engine and by utilizing the natural force of the wind are now admitted in theory and the question arises how to transform these possibilities into practical facts. This is the ground on which we meet. Science requires energetic, sport-loving aviators to verify her calcu-

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* A. Betz, "An Explanation of Soaring Flight," Zeitschrift für Flugtechnik und Motorluftschiffahrt, 1912, p.269.

** L. Prandtl, "Notes on Soaring Flight," Zeitschrift für Flugtechnik und Motorluftschiffahrt, 1921, p.209.

*** Th. v. Karman, "Mechanical Models for Soaring Flight," Zeitschrift für Flugtechnik und Motorluftschiffahrt, 1921, p.220.

****Fr. Ahlborn, "Soaring Flight," Berichte und Abhandlung der Wissenschaftlichen Gesellschaft für Luftfahrt, No. 5, July, 1921.

lations. If the WGL has supported with all its power this year's competition which is to bring us nearer the appointed goal, it is thereby fulfilling one of its highest obligations, namely, to serve the progress of aeronautics.

The conditions of the competition, as published in the spring of this year, were far from easy. He who should succeed in carrying off the big Rhön Soaring Prize for 1921 would have accomplished the feat of soaring in the air. He who could fulfill the requirements of this 30,000 mark prize, that is, keep up in the air for at least five minutes and not lose more than 50 m altitude in landing, would have succeeded in flying not only in a straight line, but also in deviating from it, perhaps even in flying in circles. The Rhön Grand Soaring Prize for 1921 was not awarded. It was suggested that the conditions of the competition for this prize be slightly changed, the same performance being required, but the conditions of landing at the close of the flight being made somewhat easier, a longer time being allowed and the pilot not being obliged to land at a given spot.

The prizes for longest total duration were intended to attract a great number of competitors, while those for the lowest mean falling speed were to compensate those aviators who could not fulfill the conditions for the Grand Soaring Prize. Less value was attached to covering a long distance, since this involved a known problem which does not require to be solved by soaring flight. Still, some prizes were set aside for the longest stretch covered in flight, in order to provide an opportunity for distance flights without engine. An important group founded prizes which they placed at the disposal of the Prize Committee, which should have the power of awarding consolation prizes, fixing handicaps, and rewarding performances for which no special prize was allotted. The name "prize for the highest coefficient of glide" hardly indicated the exact requirements. Intentionally, the value of the coefficient of glide was not given, since the glide coefficient of an airplane cannot be accurately defined in a soaring flight. This coefficient may be improved by an upward current of wind or greatly reduced by the pilot's unskillful handling. If the coefficient of glide were chosen as the measure of value, the results given would be contradictory. Only the coefficient of glide as defined by the data of the Göttingen Aerodynamical Institute was to be considered.

For winning this prize it was required to make a full turn of 360°, to accomplish three perfectly good landings and to remain in the air for five minutes. The Technical Commission was to lay before the Prize Commission a statement as to the value of the performance, the construction of the airplane (which must show some technical progress), the visibility of the pilot, the stability of the airplane (especially at lowest speed) and on its

landing qualities.

Admission tests were required both for pilots and gliders. The pilot's test took no account of previous flight with engine-driven airplanes and required only production of proof of performances of at least 0.3 km or 30 sec duration, or several flights of not less than 0.15 km or 15 sec duration, making a total of 0.4 km, with a duration of 40 sec. The glider test was to be made in several parts. An honorary official of the WGL, specially authorized, should, if possible, supervise the construction of the glider, in order to assure himself that it complied with the essential fundamental laws of airplane construction. A Test Certificate, signed by a member of the WGL, was to be laid before the Technical Commission, which had then only to make a general test of the glider. A minimum performance had also to be proved for the glider as for the pilot. In this way pilot and glider enter the competition with a slight experience of flying, so that the competition flights are not their first. This regulation caused much annoyance to Martens, pilot of the monoplane of the Hanover Akademische Fliegergruppe, since he thereby lost all credit for his first fine flight of 1.9 km. When finally the gliders had been submitted to the inspection of the Technical Commission their admission could be granted and distinctive marks given.

The testing of the gliders began on August 8th. Only a few competitors had their airplanes tested at the right time by the officials of the WGL. I should here like to express my thanks to those members of the WGL who did this work in such a thorough and expert way. The greater number of gliders had not had any preliminary tests of any kind, though these might have been carried through in the competitor's home town. Such tests were replaced by roughly approximate calculations and tests of strength on the Wasserkuppe.

The aircraft were housed partly in tents, partly in a hangar belonging to the Weltensegler Co. Ltd., of Baden-Baden, which had entered the competition and extended its most friendly help to the competitors. The tent shelters were an emergency measure and will not suffice on a future occasion. Valuable aircraft should not be housed in tents where they are liable to be damaged by weather. Even though we may see the difficulty of making suitable provision here for future contests, in the interests of future competitors the matter must not be allowed to drop.

The aviators with their mechanics found lodgings in a large, clean, wooden erection containing about 40 cubicles, each large enough for two occupants. The cubicles were about the size of a sleeping compartment on a railway train and the doors opened outwards.

The Sports Committee and the Technical Commission were very

comfortably lodged in light rooms in the huts of the Weltensegler Co. Ltd. There, these two bodies had their offices, which in bad weather also served in a modest way as a meeting place for guests. A special hut was set aside for a kitchen. At midday everybody in accordance with strict democratic principles, - aviators, mechanics, guests and members of committees, - lined up in a long queue at the kitchen door waiting for food to be handed out in portions in military fashion. In favorable weather the whole hungry crowd camped out for their meal in the neighborhood of the kitchen.

Of the 45 gliders entered for the competition, 38 remained on the spot until the end. Of these, 30 were tested, the time limit for testing having been extended to August 17th.

Unfortunately, the Technical Commission had to reject eight gliders on account of ineradicable faults of construction; that is, they were only allowed to fly under certain restrictions. If the competitors had paid more attention to the published conditions this measure might have been avoided. This year, as in the previous year, results were only obtained with gliders constructed on sound, scientific lines; it is therefore, to be hoped that in future, technical absurdities will be avoided.

No objections, or only slight ones, were raised as to the construction of 22 of the gliders presented. Of these, only 11, - that is, the quarter of the whole number entered, - competed after the ensuing efficiency test. These were:

Mark	Entrant	Type of Glider	Entrance No.
A	Flugwissenschaftliche Vereinigung, Aachen.	Monoplane "Black Devil"	29
B	Aerodyn. Institut and Flugwissenschaftliche Vereinigung, Aachen.	Monoplane "Blue Mouse"	30
C	North Bavarian Luftfahrt Verband, Nürnberg.	Biplane "Pelzner D 12"	39
D	North Bavarian Luftfahrt Verband, Nürnberg	Biplane D Nr. 11	40
E	North Bavarian Luftfahrt Verband, Nürnberg	Biplane Nr. 10	41
F	Bavarian Aero Club Munich	Monoplane	25

Mark	Entrant	Type of Glider	Entrance No.
G	Flugtechnischer Verein Stuttgart	Monoplane	43
H	Willy Drude, Berlin.	Monoplane	15
I	Akad. Fliegergruppe Tech. Hochschule, Hanover	Monoplane	45
K	Gotha Gleit und Segalflugverein, Gotha.	Biplane	18
L	Flugtechnischer Verein Dresden	Biplane	12

The Sport Committee supervised and checked the competitive flights. The member on duty carried a white flag and was accompanied by a number of helpers who kept order, checked the duration of flight, and marked off the distance flown with little flags. The member of the Sport Committee told off to announce the speed of the wind was a person of great importance. He shouted to the pilot the variations of the wind as read on the Schalenkreuz Anemometer, so that the most favorable moment might be seized for taking off.

On the Technical Commission devolved the care of completing and supplementing the methods of measurement already laid down in the regulations. At first the difference of altitude was measured by means of an aneroid barometer, but this method soon proved insufficient. Altitude and distance covered were then measured by the following simple methods. On each side of the landing place a base was marked off at right angles to the direction of flight, the base on each side having the same length. A Hartmann and Braun Balloon Theodolite, specially suitable for this purpose by reason of its simple graduation, was fixed at the point from which the glider started. The base and the angle of inclination read on the theodolite gave, with the marked-off base, by a simple geometrical ratio, the distance of flight on the ground plan and the difference of altitude. When longer distances were covered and where the height of fall did not come into question for estimating the mean minimum falling velocity, exact measurements of distance covered and difference of altitude were dispensed with. This could the more easily be done, as signals were soon placed on all the slopes at known distances and heights as points of reference.

With the exception of Klemperer and Pelzner, all the pilots were new to soaring flight. The two gliders from Aachen and the three entered by the North Bavarian Luftfahrt Verband, Nürnberg, and piloted by Pelzner, therefore were given the first places in the contest.

The performances made during the 16 flying days may be summarized as follows:

Glider Mark	Entry No.	Performances Time sec	Distance km	Pilot
A	29	170	1.370	Bienen
		75	0.596	Fromm
		100	0.705	Klemperer
B	30	1302	8.024	Klemperer
C	39	2208	21.470	Pelzner
D	40	131	1.213	Pelzner
E	41	-	-	
F	25	1897	18.443	Koller
G	43	242	2.720	Brenner
H	15	43	0.415	Drude
I	45	401	4.125	Martens
K	18	-	-	
L	12	98	1.340	Muttray
		6667	60.421	

Thus a total distance of 60.42 km was covered in 1 hr 51 min 7 sec.

All the prizes offered were awarded by the Prize Committee except the Rhön Grand Soaring Prize 1921, the conditions for which were not fulfilled.

Extract from the Decisions of the Prize Committee.

I. Rhön Grand Soaring Flight Prize 1921 (M. 30,000) not Awarded.

II. Prizes for Longest Total Duration of Flight.

	Glider	Pilot	Total Duration sec	No of Flights
1st Prize, M 5000 (Steffen & Heimann)	39 C	Pelzner	2200 1/2	27
2nd Prize M. 3000	25 F	Koller	1896 7/10	25
3rd Prize M. 2000	30 B	Klemperer	1302 1/4	12

III. Prizes for Lowest Mean Falling Speed. (Eugen von Lössl)

	Glider	Pilot	Falling Speed m/s	Time s
1/2 of 1st and 2nd Prize, M. 4000	25 F	Koller	77.5	80
1/2 of 1st and 2nd Prize, M. 4000	30 B	Klemperer	77.6	216
3rd Prize, M. 2000	45 I	Martens	103	333

IV. Prizes for Longest Distance Covered.

	Glider	Pilot	Distance m	Time s
1st Prize, M. 5000	25 F	Koller	3900	305
2nd Prize, M. 3000	45 I	Martens	3580	333
3rd Prize, M. 2000	30 B	Klemperer	2580	271

V. Prizes at the Disposal of the Committee, M. 25,000

a) Money Prizes, especially to

43 Flugtechnischer Verein, Stuttgart M.4500

29 Flugwissenschaftliche Vereinigung, Aachen M.2500

30 Aerodynamisches Institute and Flugwissenschaftliche Vereinigung M.2000

25 Bavarian Aero-Club . . . . . (M.2000 M.1000

b) Prize Cups, especially

Cup of the Berlin Verein für Luftschiffahrt for the best personal performance.

34 Weltensegler Co. Ltd., Baden-Baden, for Werner Leusch.

c) Prizes with special attributions.

M.1000 Kyffhauser-Flugspende, Frankenhausen (Wing Prize).

45 Akademische Fliegergruppe, Hanover Technical High School.

M.1000 Agis, Akademische Gesellschaft für Flugwesen, Zurich, for getting off without help and keeping in the air for 15 s;

39 North Bavarian Luftfahrt-Verband, Nürnberg (Pelzner).

M.500 Prizes of the North West group of the Luftfahrer Verband-
1st and 3rd Prizes 39 North Bavarian Luftfahrt Verband Nürnberg, (Pelzner).
2nd Prize 29 Flugwissenschaftliche Vereinigung Aachen (Klemperer).

VI. Prizes for Highest Coefficient of Glide M.15,000
Glider 45 I (Martens).

The following remarks may be made concerning the various performances.

Pelzner's Glider was especially remarkable in short flights; in longer flights, too much depended on the skill of the pilot. It is no light task to carry through numerous flights of that kind by sheer physical skill and suppleness as Pelzner succeeded in doing. Pelzner came very near finding a serious rival in Ferdinand Schultz of East Prussia. With a skill worthy of all appreciation, Schulz had put together a glider of rough, unworked wood which, unfortunately, did not come up to the required

standard of reliability. Schultz only made a few flights and those not in the competition.

Besides the flights counting for the prize, Pelzner could boast of 11 others, so that with a total of 38 flights he was by far the most industrious of the aviators. According to the conditions of the competition, it was not in Pelzner's interest to make use of the third glider which he had entered, and it is therefore not surprising that he made no flight with it.

Koller and Klemperer almost tied for the lowest mean falling speed prize, so that the Prize Committee was under the necessity of dividing the 1st and 2nd prizes. Klemperer came out very badly in his calculations, though before landing he succeeded in keeping for about a minute over the take-off point and for a considerable length of time was only a little way below it. Only when about to land was he obliged to go a good deal lower.

The prize for the longest distance covered fell to Koller, since Martens could not count his two long circular flights. Martens succeeded in making a record with a flight of 5 min 33 sec duration.

The prize for the highest coefficient of glide was awarded to the Hanover monoplane. The monoplane of the Bavarian Aero-Club and the "Blue Mouse" entered by the Flugwissenschaftliche Vereinigung and the Aerodynamical Institute of Aachen were close competitors for this prize. All three gliders were satisfactory as regards pilot's view, stability even at lowest speed and landing qualities, but the technical superiority of the Hanover glider was so marked, that it well merited the first place assigned to it.

Unfortunately there were two accidents this year also, one of which was fatal, the other causing only slight personal injuries. The monoplane of the Weltensegler Co. Ltd., designed by Wenk and piloted by Werner Leusch, an aviator of long experience in pursuit airplanes, after soaring for well over a minute above the starting point, fell with broken wings. This regrettable accident not only cut short a young life full of promise, but also eliminated from the competition a glider on which many hopes had been built. A special inquiry into the cause of the accident was made by our association and it was found that part of the warping devices were not equal to righting the glider again in a steep glide. The tests of the model in free flight had shown excellent stability and we may therefore suppose that with improved construction, the strength of the glider will also be improved. We may therefore hope for good performances from this glider in future.

Zeise's monoplane, piloted by Scharfbier, also broke, but fortunately the pilot escaped with slight injuries to the head.

Permit me now to give a summary description of the most important aircraft of the Competition.

The monoplane of the Wissenschaftliche Vereinigung, Aachen, (A 29) was the same glider that Klemperer had used for his flights the previous year. For this year's Competition, the glider no longer sufficed. In efficiency it was only slightly surpassed by its new sister plane, the "Blue Mouse" and other gliders in the competition were greatly superior to it. The lower efficiency is to be attributed to unsatisfactory wing form rather than to fundamental faults of construction. The deep cross-section chosen for the wing requires special precautions at the point of greatest camber and these were not taken in sufficient measure. The undercarriage provided good surfaces for the impact of lateral gusts of wind.

The second monoplane entered by the Flugwissenschaftliche Vereinigung and the Aerodynamical Institute of the Aachen Technical High School, the "Blue Mouse," (B 30) is somewhat lighter and only differs in small details from the "Black Devil" so that the Technical Commission could place it in the same class. If Klemperer was able to make remarkable performances with this glider, even sensational performances after the Competition, the fact may be attributed to the exceptional flying ability of Klemperer and to his thorough understanding of the problems of soaring flight. With a more modern glider, Klemperer would certainly have made far different performances.

The monoplane (F 25) entered by the Bavarian Aero-Club, had wing control. The wing, divided in the middle, could be turned by the steering rod about an axis placed at 1/3 of the chord. Backward and forward movement of the steering rod gave elevation; if acted upon from right to left, it gave various positions to the half wing and also acted on the ailerons. Lateral control was effected by means of flaps on the wing tips. At first the glider was fitted only with a stabilizer, but later the constructors decided to add a lateral fin and rudder. The builders of the glider, Messrs. Finsterwalder and von Lössl, believe that wing control gives the means of utilizing more rapid gusts of wind than would be possible with airplanes of the usual construction, that is, with a rear elevator.

This method of wing control involves the danger, not denied even by the constructors, that in exceptional cases when the glider is flying at high speed, a good deal of force will be brought to bear on the steering lever. In a glider weighing about 130 kg it should never, under any circumstances, be necessary to apply great force to the steering lever. During the competition the glider gave good performances in 25 flights, all made in favorable weather. The pilot, Koller, after some experience with the

glider, succeeded in steering it steadily in calm weather. It cannot be denied that the efficiency of the glider in stormy weather is doubtful, as it has never flown in a storm. It is, however, of the utmost necessity that a glider should be able to fly in a storm. As lateral control proved to be impractical or ineffective with the flaps at the wing tips, a change was made during the competition, the flaps being enlarged, and a rudder being added.

The glider of the Stuttgart Flugtechnische Verein (G 43) is a well-built monoplane which, once in flying trim, showed considerable efficiency. Its pilot, Brenner, twice covered a distance of about a kilometer and made good landings. Unfortunately, the glider got out of control while the pilot was attempting to describe a closed circle. This was very regrettable both for the competition and for the Stuttgart people.

The monoplane of Willy Drude, Berlin, (H 15) had a very large wing area, but a small aspect ratio. It would certainly have furnished some performances if the owner had been a more skillful aviator, in spite of the fact that there were some technical faults in the construction.

The monoplane of the Akademischen Fliegergruppe of the Hanover Technical High School (I 45) only arrived on the field towards the close of the competition. This glider is remarkable in various ways. The aspect ratio (ratio of wing chord to span) has been chosen very high (1 : 9.6). Especial care has been taken to reduce head resistance. The constructors, well supported by the counsels of MM. Dorner, Madelung, and Pröll, and by the practical help of the Hanover Waggon Works, carefully chose a wing section which shows an exceptionally favorable value for falling speed, c_a^3/c_w^2. The wings are of a typically expert type, being not only fixed, but also rigid. The wing is so formed that the ribs are carried by a main spar which joins the leading edge and prevents torsion. The factor of safety of the wings is given at over 6. The fuselage is simple in form and covered with plywood. Three leather balls, something like footballs, set on axes, serve for taking off. The wing tips are protected by air-cushions covered with leather. The observed landings have shown that the glider is strong. On the occasion of the last start in the competition, it came down with its right wing on the ground, bumped hard on the fuselage and turned over on the tip. The damage sustained by the fuselage was quite unimportant. In the wing only a small fitting joining the outer part of the wing to the center was torn off, causing a little further damage to the wings. The ease with which the wings can be detached from the fuselage should be noted; this makes it possible to transport the glider very quickly. It is to be regretted that this glider competed in only three flights, but these were sufficient to show its great superiority. Unfortunately, it had no chance of showing

what it could do in soaring flight; certainly very good performances might have been expected.

The biplane of the Gotha Gleit und Segelflugverein (K 18), was well designed and carefully calculated, but the pilot did not succeed in getting any performance out of it. The same remark applies to the monoplane (17) entered by the same competitor, which did not put in a further appearance.

The biplane of the Dresden Flugtechnischer Verein (L 12) was built as simply as possible and turned out to be rather heavy. After some preliminary attempts, the pilot, Muttray, succeeded on the last day in achieving a rather big flight, to the satisfaction of all who had observed the work of the Dresden people.

All the gliders mentioned above were controlled by hand and foot levers in the way usual on military airplanes. Pelzner, on gliders C 39, D 40, E 41, entered by the North Bavarian Luftfahrt Verband, Nürnberg, may be mentioned as the chief exponent of the use of distribution of weight in control.

The weight of the gliders was made as small as possible (on an average of 15 kg) and the joints were made so as to be easily repaired since, even with the utmost dexterity in piloting, such an aircraft is more exposed to danger in landing than one fitted with the usual type of undercarriage.

So much for the description of the gliders admitted to the competition.

Of the others, only a few are worthy of notice.

The best of these is the monoplane 34 of the Weltensegler Co. Ltd. This glider has very good longitudinal and lateral stability. It consists of a central, lifting portion, and two outer portions which are swept back and have a smaller angle of incidence than the central portion. This glider somewhat resembles an airplane built by Dunne about eight years ago. The large span, about 16 m, gives a good aspect ratio (1 : 11). The small load per square meter enables the glider to fly even when there is not much wind. It is controlled by means of simultaneous or alternate warping of the wing tips. The control wires are so arranged that they act only during descent; in climbing, counter springs come into action. It is to be presumed that in the flight which terminated so unhappily, these springs proved insufficient to right the glider. On August 14th, Werner Leusch succeeded in keeping the glider soaring in the air for some considerable time over the starting point. Those who had hitherto not believed in the possibility of soaring flight, now had an impressive example of it before their eyes.

Unlike all the other aircraft carried to the point of flying, the monoplane of the Weltensegler Co. Ltd. possessed very good inherent stability. This quality was the especial aim of its inventor, Wenk. It has not yet been decided whether it is worth while to endeavor to attain high stability in gliders, or whether we shall reach our aim quicker by means of less stable aircraft inherently. Good stability gives the pilot much less responsibility. He has only to attend to the changes in altitude and lateral direction, while with a less stable glider he must pay constant attention to the controls. In the future we may have to develop both kinds of aircraft. Everyone was greatly impressed by the model monoplane of the Weltensegler Co. Ltd., which showed exceptionally good qualities even with a different wing tip arrangement.

Friedrich Budig's biplane (26), a "Canard" type glider, was fitted with an automatic stabilizing device, actuated by the suction of an enclosed air stream from an auxiliary horizontal surface in connection with the elevator to the wing. By various angles of incidence or by various speeds of flight, changes are brought about in the internal pressure which are transmitted directly to the elevator.

Budig exhibited his device exposed to the wind. The action of the fluctuations of the wind on the elevator could be seen clearly. The glider did not fly as there was not sufficient wind. Presumably, the stabilizing device can be used during flight, but experience only will prove its use to the pilot.

The two monoplanes of Alfred Zeise (20, 21) are of the bird-like type, controlled by the action of the wings. The elevator was very small, so that only imperfect longitudinal stability could be expected. The glider was very carefully constructed. On the first flight it turned on its nose and struck the ground vertically. This accident shows that control depending on the position of camber, which is the same thing as control by shifting the center of gravity, is impracticable for small angles of incidence. Mr. Hopf has lately especially referred to this danger. In the next competition, such gliders must be given special preliminary tests for controllability.

The monoplane entered by Fritz Schweizer, Gersfeld (44) and built by Lippisch, is carefully designed and carefully built, even to details. The wing area is very small and therefore the airplane will probably only be able to take off in a very strong wind.

Two gliders were shown built on the Gustave Lilienthal principle. These are No. 14 (von Lüttwitz) and No. 27 (Karl Rath). These did not fly and simply formed an exhibition for the spectators who greatly admired the bird-like shape of the gliders.

In reviewing aircraft construction, some zealous manufacturers must not be left unmentioned. Karl Kammermeyer of Ulm, working in collaboration with young Peter Riedel and Mr. von Lüttwitz as well as on his own account, brought a glider for each of them to the Rhön. Kammermeyer's mechanical achievement was especially noteworthy, and it is a pity that his ability was directed on wrong lines. Something of the same kind may be said of Gottlob Espenlaub who built a monoplane (13) in a Swabian village where technical advice was not available. The wings of this monoplane showed good ability to grasp the main lines and it is a pity that they were rendered useless by insufficient bracing.

Taking the technical points of the gliders as a whole, it must be admitted that there is much improvement over the gliders seen in the previous year. Only such gliders were admitted to the competition as were built in accordance with the latest technical data, that is, which aimed at using the developments of aerodynamics and statics as applied to aircraft. All competitors who relied solely on their inventive genius were ruled out.

The process of development seems to be on the lines of the non-braced or slightly braced monoplane. The thick wing section which, for various reasons, is favorable for gliders, permits of placing thicker wing spars, thereby doing away with the need of other bracing. Parasite resistance can be reduced by the elimination of the undercarriage with high rear skids, only necessary on engine-driven airplanes.

There is also a movement towards large wings of considerable span. Up to the present it is considered that wing load should be about 10 kg/sq.m.

There is no object in keeping the weight of a glider excessively low. A glider weighing about 80 kg can be made much stronger and more rigid in all its parts than one having an empty weight of 40 kg. Since the weight of a glider with pilot will be from 120 to 160 kg the difference in total weight need hardly be considered. The greater wing dimension required for greater weight is easily arranged for.

When unrestricted as to weight of construction, the airplane can be built very strongly. It would then be easy to construct gliders with a load factor of 8 for the wings, diminishing according to the load. When a wing has such a high load factor the strength of the glider is easily verified by means of simple strength tests. A monoplane with supports under the wing tips, the weight of the pilot in the center forming the test load, will certainly inspire confidence. The other parts of the glider must also be made sufficiently strong. The rudder worked by foot action, the seat and belt attachments should be on pretty much the same principles as those in an engine-driven airplane. Great care

should also be taken that the controls are strongly constructed and within easy reach of the pilot. In this respect the Hanover monoplane may serve as a model.

In many of the gliders the controls were very imperfect. There were some which required a greater expenditure of power than is required for our largest aircraft. That is a serious defect which might easily be avoided by carrying the control wires over bearings of large diameter, so arranged that there would be no loss due to friction.

Wing warping is an excellent help in lateral control. It causes, however, confusion in the proportions of the wings, and difficult control action. The advantage of a warping wing does does not compensate for the consequent static difficulties in the construction of the wing and the difficulty of control.

The method adopted for starting the Aachen glider was generally followed. Although it is obviously simple and effective to start the glider by means of a long spring attached to the nose and drawn by men experienced in the work, the picture is not very pleasant to look upon when, from any cause, the men pull unevenly. The failures in starting of the Dresden and Hanover gliders left no doubt on this point. The ambition to take off with as little help as possible, seems to me to be overdone.

The old device for starting gliders, the catapult used by the Wright Brothers and later by Offerman, is a simple, reliable and suitable device for launching the glider into the air, even in calm weather. On the Wasserkuppe I had the opportunity of speaking of the practicability of the catapult with Mr. von Parseval, who has done much in spreading this idea. I am pleased to feel that we agree as to the merits of the catapult The teaching of soaring flight and gliding flight will also gain by the use of a glider catapult. I have been told that after the Competition a new, certain method of starting on a straight course was employed with success. The starting cable was laid along the ground on fixed pulleys at a distance from the path of the glider. The pull of the starters was therefore at right angles to the direction of the take-off.

As in the previous year, there was a Weather Bureau on the Wasserkuppe, directed by Dr. Roth and Dr. Georgii, collaborators of Dr. Linke. To all these gentlemen our best thanks are due.

As there was no telegraphic connection between the Wasserkuppe and Gersfeld, the Huth Radio Co. Ltd. of Berlin set up a wireless telephone service between the two places during the competition. Besides the receiving station for weather, time, and press services, there were also two communication stations for

radio telephone fitted with 10 W power and placed at our disposal. In order to have direct communication between the management and the competitors, the stations were fitted both for receiving and sending. In order to use the apparatus it was only necessary to take down the receiver.

Unfortunately, communication could only be generally established on August 19th. It was quite easy to speak through these instruments, the voice coming through quite clearly, except sometimes in the case of unavoidable atmospheric disturbances which accompanied the numerous thunderstorms.

I should like here to offer my heartiest thanks to the Huth Radio Co. Ltd. for its effective help in the Rhön Competition.

We have before us the question whether, and in what way, soaring flight can be further supported by the WGL. We are not yet so far on as to be able to affirm what its further developments will be. This young art of flying is still in need of active help.

A striking circumstance, not at all due to chance, is that in this contest the final competition was between the Technical High Schools. Even though the Academical Associations did not always enter openly as competitors, it was almost without exception the students of the Technical High Schools who disputed the palm of victory. In this fact I am glad to recognize an outlook full of promise for the further development of soaring flight. When the ambition of the various teaching centers is pitted one against the other, when in Aachen, Hanover, Dresden, Darmstadt, Munich, Stuttgart and other places, enthusiastic aviation students find competent teachers to give them intelligent help in the computation and building of their gliders, when former students of the schools give pecuniary aid, then there will be keen competition which will lead to the developments desired. It is hardly necessary to say that competition between the Technical High Schools will not exclude other competitors from participating.

Meanwhile, the Rhön has become the rallying point of soaring flight. Klemperer's last flight to Gersfeld showed the wonderful possibilities of flight in the Rhön. Most people will certainly give the preference to the Rhön district. The possibilities of installation have been greatly facilitated by the settlement of the Weltensegler Co. Ltd. in the place.

Lately there was a question of holding a competition in the dunes of East Prussia. It seems to me that this should not be undertaken until several soaring flights like those of Klemperer have been accomplished.

Others, arguing from the uncertainty of the weather conditions in a competition fixed at a given time and place, are in favor of flights to be executed within a long period and in any part of the country, emphasizing the fact that this method would eliminate the expenses of a meeting. Although the advantages of such a method are not to be lightly set aside, it must be said that a soaring flight competition in the beautiful German mountains is an event of considerable importance to all those taking part in it and is much talked about afterwards. A report in the morning paper of a successful soaring flight is a very poor substitute for the joy of actually seeing the flight and taking an active part in it.

The wish has been expressed to have small engines in gliders. This would certainly have a great influence on the conditions of a soaring flight competition. Taking into consideration the fact that it is necessary to centralize our endeavors, I cannot agree that the time is ripe for holding competitions for engine-driven gliders.

Whatever decision may be arrived at for the furtherance of soaring flight, you will all agree with me that the new method of flying must be pushed forward with full force.

The lecture was illustrated by a film taken by Mr. A. H. G. Fokker during his stay in the Rhön and lent to the WGL. The start, flight, and landing of the gliders entered for the competition were shown, and also some snapshots of the contest itself.

Professor Linke- Ladies and Gentlemen: In Dr. Hoff's lecture on soaring flight which he has so well and thoroughly explained in all its branches, he gratefully recognized the activity of the organizers, the South-West Group of the German Luftfahrverband and the Verband der Modell und Gleitflugverein. I would not fail to express the thanks of the organizers for the far-reaching help of the Wissenschaftlicher Gesellschaft für Luftfahrt. This association not only formed a Soaring Flight Commission under the presidency of Dr. Rumpler, which undertook to receive the entries, but also succeeded in endowing the contest with important prizes. It had also the intention of contributing towards the expenses of the competition, though the result fell short of the amount promised. However, we accepted it gratefully. It is to be hoped that the WGL will decide to continue its support of soaring flight and that next year we shall again find organizers who will work harmoniously with it. It is to be hoped that the work of organization will again be taken up by the South-West Group and by the Verband der Modell und Gleitflugverein.

Allow me to say a few words on the subject as a meteorologist.

It is quite clear to all of us here that the power to be obtained does not depend simply on the section of the aerofoil, but must come from an external force. That force can only be the wind. We may distinguish between two different possibilities:

1. At a certain inclination of glide the wind must have a certain component of lift. It is thought that this component of lift provides, in large proportion, the energy required for soaring flight.

2. The second theory is that gusts of wind should be utilized. The more the aviator is able to equalize the inequalities in the air, so much more power will he be able to extract from it. If the air can be retarded or accelerated, the power of the aircraft is retarded or accelerated in like manner. This, however, can only be done with gusts of a certain duration. We distinguish between long "meteorological" gusts (storm gusts) and short, flying gusts. When we draw a curve showing the velocity of the wind, we see that this velocity does not remain constant, but is subject to rapid changes. The more this curve is extended, the greater inequalities we discover. If we show on a curve 10 cm long the values registered in one hour, we shall see that there were several rather long rises and falls and also some shorter ones. If, however, we take the records for a shorter period, say one minute, and show them on a curve 10 cm long, it will appear, if we use a sensitive instrument, that the deviations are more turbulent than before. We must thus distinguish between this turbulence and the gusts of wind. Gusts are long changes which require some minutes for their development. Although the small changes due to turbulence may have the same acceleration as the gusts and often greater power, they cannot be utilized by the aviator because the glider passes over them too rapidly. Aviators can only utilize slow changes which last for more than 15 seconds. Only then has the pilot time to place the glider on the gust and to direct it or warp the wings, all the time reacting on the change. These gusts which last from 15 seconds to 2 minutes, have sufficient power to be utilized by the aviator. Rain squalls for the most part have too little acceleration to be of use to the aviator and thunder squalls are too dangerous.

The small squalls which can be used, and have been used by aviators contain, however, only a small part of the power required for soaring flight. Hence the question: Shall we go to the coast with our gliders, or not?

On the sea coast there are certainly upward air currents and a small hill always to be found. There is also another thing to be considered: When the wind is blowing in from the sea the friction over the sea is very slight. As soon as it reaches the coast the friction suddenly increases. Further up, however, there

will be frictionless air. There thus arises a damming up of the air and a stronger upward current than the profile of the coast would lead us to expect. On the sea coast there is thus an up-upward current which can be utilized, but it is not so strong as in the mountains. So long as soaring flight is in the early stage of development we must remain in the mountains. The next stage will be soaring flight on the coast and there we shall be able to utilize the squalls. I believe, however, that sea squalls do not contain so much power as those in mountainous countries.

I would therefore support the recommendation of Dr. Hoff that the Soaring Flight Competition of 1922 be held, as before, in the mountains, unless it is proved by practical experiments on the coast that soaring flight is possible there. I would also remark that a storm wind is more squally than a regular wind and the squalliness varies from 4 to 8 m. On the coast the wind frequently reaches over 8 m, but unfortunately, satisfactory measurements are lacking. Researches made on this point by industrial concerns should be supported by us.

Lt. Col Siegert: After the first flights in the Rhön Soaring Flight Competition of 1920, it soon appeared that the title "Soaring Flight Competition" was not quite accurate, and we came to the conclusion that the year 1920 should be considered simply and solely as a preparation, a set of experiments. The year 1921 promised to bring an experiment on a large scale and we should like to conclude with a competition in 1922.

This line of development, then accepted in theory, has proved correct in practice, and acting on the knowledge thus acquired, suggestions for carrying on the work were made by the Konigsberger Verein and the Luftfahrerverband. The former has undertaken to prepare for the first attempt to be made over water in or before 1923.

For my part, I do not think that such an experiment can be concluded within a year. I think it will take till 1926. Without knowing what the practical result will be, it is interesting to follow the lines on which further development will proceed. These ideas have come to us from Munich, though I think they are not well known. A short article by Engineer Wolfmüller, inserted in "Flugsport" has given us entirely new ideas on reverse soaring flight. The article was not widely read because it was hidden away among a lot of formulas, etc. It is to be noted that Wolfmüller does not make soaring flight depend on zones of temperature, but on the various layers of the wind. Briefly, his system is as follows:

It may be assumed that during the greater part of the year the upper glider will be in a wind of different direction from that of the lower. Under these conditions the gliders can remain in the air indefinitely. This is the true idea of soaring flight. It follows that all experiments hitherto made have been as sport or disguised gliding flight, unless in the Rhön competition of next year the condition is fulfilled that a competitor shall land 20 meters higher than his starting point.

Prof. Dr. Polis: In soaring flight it is required to utilize the various kinds of air movement both according to the state of the weather and according to locality. In addition to the great interchange of air between fields of high and low pressure, manifested both in horizontal and vertical movements - descending from centers of high pressure, ascending from centers of low pressure - there are local air currents suitable for use in soaring flight. Such local air currents occur both in mountains and on the coast. In the mountains they are known as mountain winds and valley winds - in the daytime flowing upwards from the valleys, by night flowing downwards. They are also known as land winds (by night) and sea winds (by day). Generally, an air current flowing up against a mountain side blows over it, producing an upward current on the windward side and a downward current on the lee side. Periodical air movements develop in calm weather on the boundaries between water and land and also by lakes, large rivers, etc. A typical example of this is afforded by Golzheimer Heath near Dusseldorf, the well-known airship port, which is half encircled by the Rhine. By day the wind blows from the colder stream to the warmer heath and the prevailing southwest winds are then changed into a more westerly to west-northwest current.* The development of hot gusts of wind, which caused much damage to the Zeppelins, is to be attributed to the overheating of the lowest strata of air, a consequence of the great capacity of the sandy ground for absorbing heat. The air over the Rhine, and also high over the heath, remains, however, relatively cold and there are therefore considerable differences of temperature between the horizontal and vertical directions which favor the formation of a condition of unstable equilibrium.

In order to carry a soaring flight to a favorable altitude,

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* The airship hangar on Golzheimer Heath was placed according to the general prevailing direction of the wind (SW to NE). This caused a deviation of the wind on the heath, so that the current blows mostly straight across the hangar.

we must make full use of the various kinds of air currents - mountain winds and valley winds, land winds and sea winds. The most suitable currents will be those which have short wave lengths, carrying the glider upwards and forwards. Such short* wave movements occur in turbulent air. Therefore, in an exhaustive study of the wind it will be necessary to measure the velocity of the air currents, especially of isolated impacts, and also the length of the waves. For measuring isolated impacts a pressure and depression anemometer will be used (Steffens-Heddescher gustometer). As is well known, the rotating anemometer only gives mean wind values. Further experiments must first be made in mountainous districts, in order to bring the technique of soaring flight to perfection. There must, however, be close collaboration with meteorology and the air currents must be thoroughly studied so that they may be utilized both with regard to the state of the weather and local conditions. Even in the neighborhood of Aachen such experiments can be made, for we have unwooded hills over which blow northwest and westerly winds. The labors of the Aerodynamical Institute and of the Meteorological Observatory will be coordinated and complementary, directed according to the aim in view. Airship navigation will also profit by such experiments since the further development of soaring flight together with a thorough study of air currents in relation to aircraft construction involves the best methods of utilizing the wind.

Von Parseval: Your Royal Highness, ladies and gentlemen:

My reason for wishing to speak is to urge the WGL to hold fast to the programme. That seems to me to be the reasonable course, and I must make that statement as a prefix to my further remarks. But there is also a second consideration, which is that the scientific side is of as much importance as the sporting side.

In building gliders there are three factors involved and these three must work together if there is to be good performance. The first is the pilot; the second, the glider; the third, the wind. We are now dealing especially with the question of the design of a good glider. We cannot judge of its excellence when we consider at the same time three such complex factors as the glider, wind, and pilot. We must eliminate two of the factors in order to see the third clearly. I therefore suggest that, besides the competition prizes which were offered this year and will also be offered next year, a special prize be set aside for a glider having good gliding flight and that the test flight shall be made when there is no wind. In the Rhön I saw for myself that opportunities for such tests would not be lacking, and days unsuitable for other kinds of flight could be utilized for this purpose.

* Waves of greater length are, for instance, the wave clouds in which are found waves of some kilometers in length.

A second condition must also be required. There must be a starting device for the glider. On a level spot a starting place will be arranged on which, perhaps, a long spring will be laid which has simply to be pulled. If possible, and if it is desired to do the thing in style, this spring can be fitted with a speed indicator which will give the speed the glider has attained. The glider which flies the furthest will be considered the best. We should thus get a clear, technical result. We should get coefficients which can be used in calculation, and these are necessary for a professional technician.

Prof. Linke: In ship navigation, by the term "sailing" we mean navigation in two different media - water and wind. What we mean by "sailing flight" is not exactly the same as what we mean when speaking of ship navigation, for in flight, the "sailing" consists, for the most part, of being carried along on an upward air current. Yesterday I mentioned that, whether in the mountains or on the coast, where such an upward current of air is evolved the necessary preliminary conditions are provided, or that the acceleration of the air in gusts can be utilized by making use of the principle of inertia. Since, however, we have currents of different strength and direction at different altitudes, the fundamental conditions of real "sailing" are also provided, as when there are two aircraft at different altitudes connected with each other. This third sort of sailing flight may perhaps be utilized in sports.

It would be a great help for our young people if some one would take the trouble to write a book on the subject of soaring flight, a book which should set forth clearly the technical experiments of the recent years and also the general principles above mentioned. In the Rhön, I saw that beginners often set to work with ideas far from clear, partly learned from older writers, from books containing statements which are out of date. Therefore, I wish that a new book might be written. I would like to suggest that some one who has thought the subject out thoroughly both on the technical and meteorological side should write this booklet, and that all the experiments we have made should be included therein. This would increase the interest in soaring flight and would lay foundations on which results would be built.

Additional Notes
by Dr. Hoff.

An untoward circumstance prevented my taking part in the discussion on my lecture on September 6th. I must therefore write a few lines to take the place of what I should have said at the close of the discussion. I welcome the opportunity of bringing to your notice some fine flying performances which took place in the Rhön during the month of September.

I quite agree with Prof. Linke and Prof. Polis that soaring flight depends, to all intents and purposes, on meteorological conditions. Where there is no wind, there is no soaring flight. Aviation is glad to get indications from meteorology concerning such regions as have regular air currents in sufficient quantity to be of use in soaring flight. A great deal of the work of helping on soaring flight will be accomplished by meteorological research. The further we advance in the utilization of the natural energy of the wind, the more numerous will be the kinds of such energy that we shall be able to use. Probably these are limited only by the size and speed of our aircraft. In order to utilize the air currents and vortices, the glider must be of sufficiently small dimensions, otherwise it will not be influenced by such currents and vortices. The duration of this influence must not be unduly shortened by the excessive speed of the glider. Experience will teach us where the practical limits lie.

Lt. Col Siegert hopes for greater results from the coming competition than we had hitherto thought of. The September performances in the Rhön seem to have set the pace. The suggestions of Wolfmüller, Munich, rest upon good physical foundations, but there is much experimental work to be done before a system of two aircraft connected together moving in different layers of air and at different speeds and directions, can be brought to actual, incontestable flight. At present, I do not see any favorable outlook for this kind of flying.

Prof. v. Parseval is right in saying that the greatest attention should be paid to the scientific results of the coming competition, and under this head comes also the knowledge of the gliding factor. It is very important to use a catapult in making the tests and in training inexperienced pilots.

The wish of Prof. Linke to provide a simply written, elementary book on soaring flight for the use of boys interested in aviation, is worthy of support. Unfortunately, and in spite of the best will in the world, those fitted to write such a book have but little time at their disposal.

In September, 1921, the following new soaring flight performances were made known:

On September 5th, Martens, on the monoplane of the Akademischen Flieger Gruppe of the Hanover Technical High School, took off from the northern slope of the Wasserkuppe, gained in altitude, and flew in the direction of Reulbach over the Königstein and along the slope of the Ehrenberg Mountains, varying his altitude. After five minutes' flight, the height of the glider, judged by reference points in the surrounding country, was estimated at about 800 meters. Continuing its flight, the glider sailed along

Hilders Forest, alternately gaining and losing height, and finally, after a flight of 15 min 40 sec, landed 250 meters east of Batten Village. The ground measurement of the distance covered between starting point and landing point was 7.5 km, and the difference of altitude 400 m.

During the Rhön competition, Constructor Harth and Willy Messerschmitt had gone to the Heidelstein, a mountain with a long, gentle slope southeast of the Wasserkuppe and there, free from the annoyance of undesired spectators, worked industriously at their flying tests of the previous year with a glider of their own design. On September 13th, a very gusty day, Harth took off without any help and flew several times round the starting point at pretty high altitudes. After a flight of 21 min 37 sec, he landed only 12 meters below the starting point. The value of this splendid performance lies as much in the duration of flight as in the fact that the flight was accomplished over only slightly sloping country. This soaring flight of Harth on September 13th went far beyond the point aimed at in the Rhön Soaring Prize of 1921. It is to be regretted that it was made with so much secrecy, thus preventing the official recognition of the efficiency of the pilot and of the glider. Still we have no ground to question the result stated, and we would express the hope that Mr. Harth, who met with a sad accident in a later flight, will soon be well again and able to take up the work with his friend and collaborator, Messerschmitt.

At the close of the meeting of the WGL a lively discussion took place on the tests to be set for the new competitions. The duration of flight and the position of the landing place with respect to the starting point are two simple standards of value which can easily be controlled. The flight of shortest duration set for the gaining of a prize must not be made too difficult, for we know that wind currents helpful to soaring flight are seldom of long duration. As to landing, the only condition laid down should be that there shall not be more than a certain difference of altitude between starting point and landing point; otherwise the choice of a landing place shall be free. The test length of flight can only be set on the spot and where the local conditions guarantee with some degree of certainty the winds necessary for soaring flight.

Translated by the National Advisory Committee for Aeronautics,
Paris Office.

CHARACTERISTICS OF GLIDERS ADMITTED TO COMPETITION.

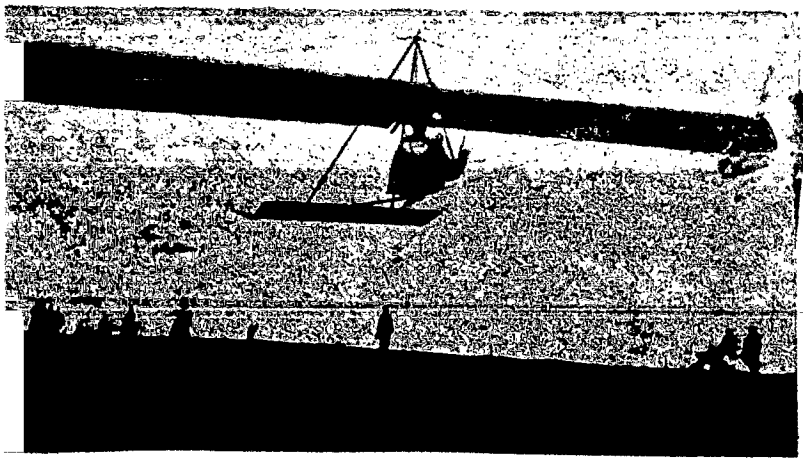
Mark Entry No.	A 29	B 30	C 39	D 40
No. of planes Span (m)	1 9.400	1 9.500	2 5.400	2 6.000
Mean wing chord (m)	1.700	1.685	1.450 (upper) 1.20 (lower)	1.260 (upper and lower)
Aspect ratio	1 : 5.32	1 : 5.63	1 : 3.96 in center	1 : 4.76
Wing area (sq.m)	15.0	15.5	14.0	16.0
Wing section	Thick	Thick	Thin Under surface slight reverse curve.	Thin Under surface slight reverse curve. Large camber.
Longitudinal control Elevator (sq.m) Stabilizer (sq.m) Moment arm (m)	Not balanced. 1.5 1.8 4.32	Not balanced. 1.5 1.8 4.32	No elevator. Control by shifting weight.	No elevator. Control by shifting weight.
Lateral control Rudder (sq.m) Fin (sq.m) Moment arm (m)	Not balanced. 0.5 0.6 4.32	Not balanced. 0.5 0.6 4.32	Lateral fins	Lateral fins
Aileron control Ailerons (sq.m) Moment arm (m)	Not balanced. 1.52 3.62	Not balanced. 1.52 3.64	Without aileron control by shifting weight.	Without aileron control by shifting weight.
Estimated weight (empty) (kg)	65	53	With fuselage 11.5 Without fuselage 9.8	16.0
Total weight (kg) (pilot = 75 kg)	140	128	With fuselage 86.5 Without fuselage 84.8	91.0
Wing loading kg/sq.m.	9.3	8.3	Without fuselage 6.18 With fuselage 6.05	5.7

CHARACTERISTICS OF GLIDERS ADMITTED TO COMPETITION (Contd.)

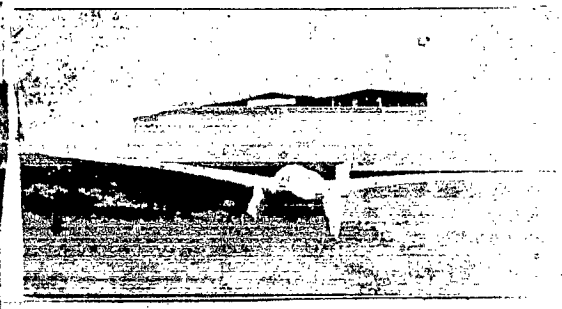
Mark Entry No.	E 41	F 25	G 43	H 15
No. of planes	2	1	1	1
Span (m)	6.800	11.000	7.440	9.000
Mean wing chord (m)	1.550	1.500	1.35	1.95
Aspect ratio	1 : 4,4	1 : 7.35	1 : 5.5	1 : 4.6
Wing area (sq.m)	17.0	15.0	14.0	17.6
Wing section	Thin Spars cause protuberance on upper surface	Thick	Fairly thick, thinner towards edges & curved.	
Longitudinal control Elevator (sq.m) Stabilizer (sq.m) Moment arm (m)	No elevator. Control by shifting weight	No rudder, only fins 1.5 2.70	Not balanced 0.79 0.78 3.68	Not balanced rudder
Lateral control Rudder (sq.m) Fin (sq.m) Moment arm (m)	Lateral fins	Flaps on wing tips to help in lateral control	Not balanced 0.19 0.40 3.68	Not balanced rudder
Aileron control Ailerons (sq.m) Moment arm (m)	Without aileron control by shifting weight	Wing displacement	Not balanced 1.08 2.84	Warping of wings
Estimated weight (empty) (kg)	19.5	56	60	55
Total weight (kg) (pilot=75 kg)	94.5	131	135	130
Wing loading kg/sq.m	5.6	8.7	9.7	7.40

CHARACTERISTICS OF GLIDERS ADMITTED TO COMPETITION (Contd.)

Mark	I	K	L
Entry No.	45	18	12
No. of planes	1	2	2
Span (m)	12.600	6.800	7.800
Mean wing chord (m)	1.28	1.450 (upper) 1.250 (lower)	1.450 (upper) 1.200 (lower)
Aspect ratio	1 : 9.6	1 : 4.5 in center	1 : 5.2 in center
Wing area (sq.m)	16.0	12.70	17.60
Wing section	Thick, similar to Joukowsky section	Fairly thick	Fairly thick
Longitudinal control	Balanced rudder without fins	Not balanced	Not balanced
Elevator (sq.m)		1.80	1.12
Stabilizer (sq.m)	1.9	0.24	1.82
Moment arm (m)	3.56	2.90	2.7
Lateral control	Not balanced	Not balanced	Not balanced
Rudder (sq.m)	0.38	0.28	0.4
Fin (sq.m)	0.65	1.20	0.4
Moment arm (m)	3.15	2.90	2.7
Aileron control	Warping and aileron	Not balanced	Warping of wings
Ailerons (sq.m)	1.04	2.10	
Moment arm (m)	5.30	2.55	
Estimated weight (empty) (kg)	100	59.0	60
Total weight (kg)	175	134	135
Wing loading kg/sq.m	10.9	10.6	7.7

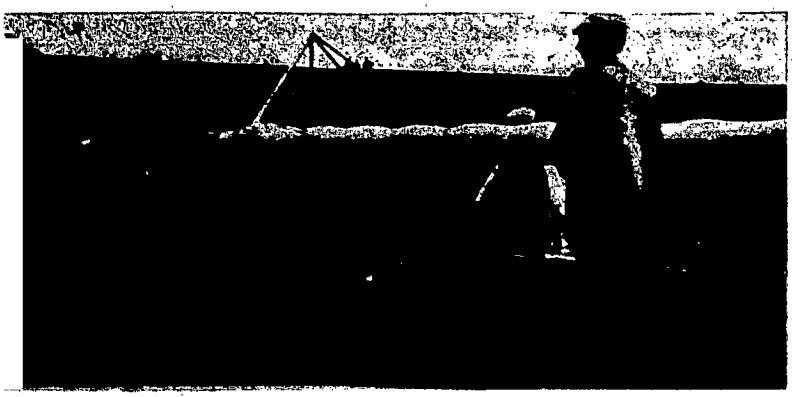


"Koller" in flight, F 25.

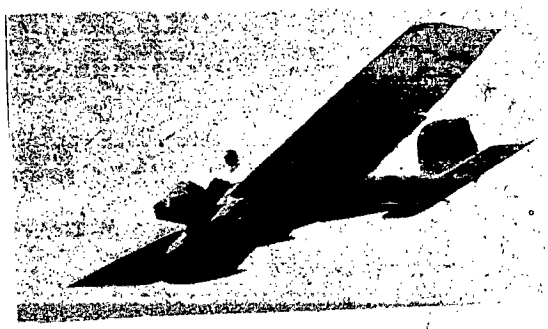


The "Blue Mouse", B 30

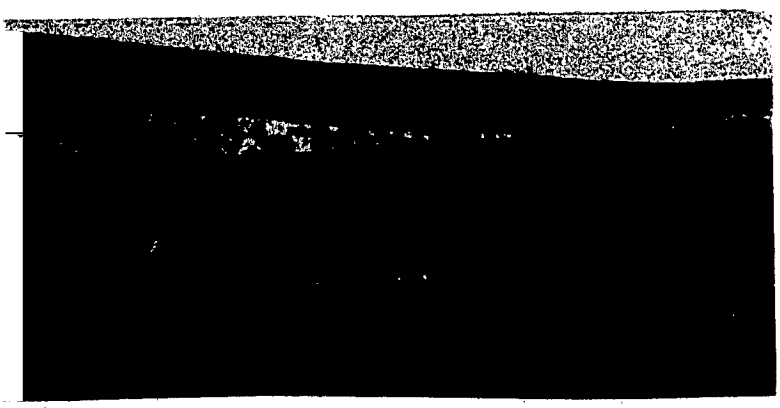
Monoplane, Willy Drude,



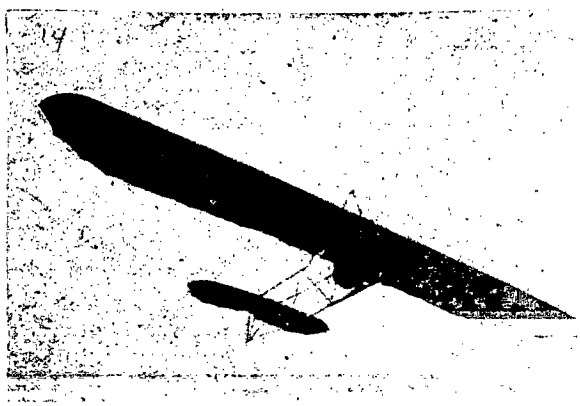
ne of Bavarian Aero Club (Front view). F 25.



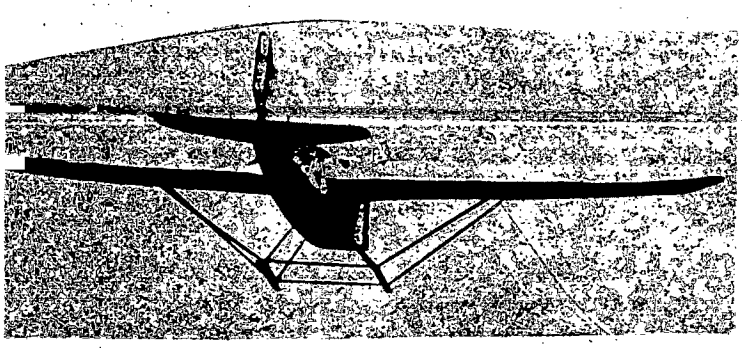
"Black Devil, A 29.



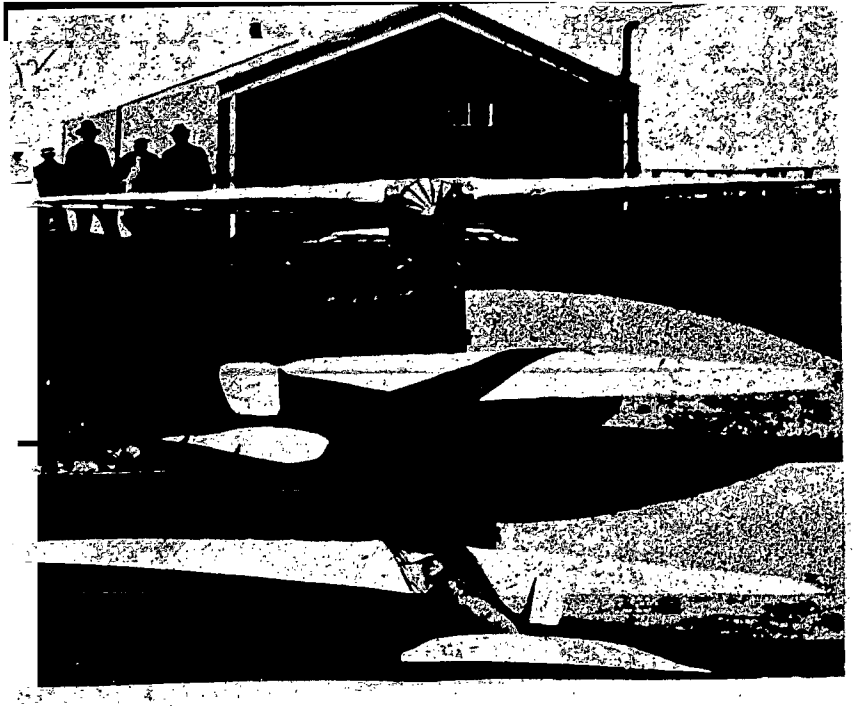
(K 18) of the Gotha Society for gliding & soaring



Harth-Messerschmitt Monoplane.



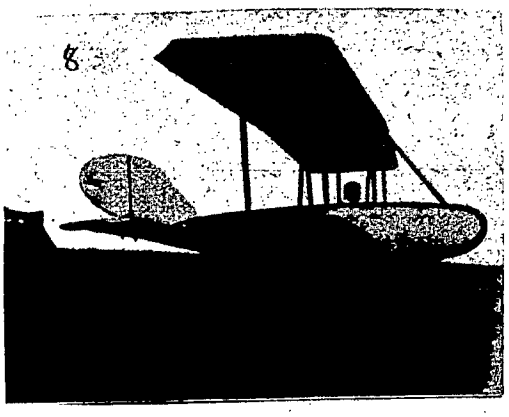
"Brenner", in flight, G 43.
ane of Aeronautical Society of Stuttgart.



Schweizer-Lippish Monoplane

Biplane with Pelzner in flight
(C 39)
North Bavaria Aviation Club,
Nuremberg.

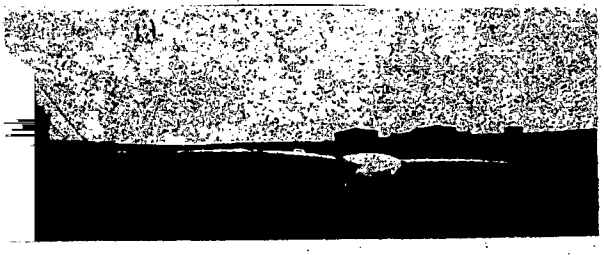
ıue view of monoplane (I 45) of Aviation Club of
ver Technical High School.



Biplane of the Dresden Aviatio
Club.

L- 12

Biplane of Friedrich Budig.



Monoplane of Alfred Zeise

Monoplane of Baron von Luttwitz

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