TECHNICAL MEMORANDUMS

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

No. 433

SOME GERMAN GLIDERS OF 1920-1923

By Alfried Gymnich

From "Der Gleit- und Segelflugzeugbau"

Washington
October, 1927

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS.

TECHNICAL MEMORANDUM NO. 433.

SOME GERMAN GLIDERS OF 1920-1923.*

Pelzner "Hang Glider"

This glider (Fig. 1), which was designed and built by Pelzner of Nuremberg, gave a good account of itself in the 1920 and 1921 Rhön contests. Its relatively simple construction and low cost, together with its light weight and ease of taking apart for transportation, rendered it an ideal aircraft for sport.

The upper wing was staggered a little in front of the lower wing, though its chord was the same. Each wing had two spruce spars with ash upper and lower flanges in the following dimensions: Front spar, upper and lower, 4 x 0.5 cm (1.57 x 0.2 in.); rear spar, upper, 3.6 x 1.1 cm (1.42 x 0.43 in.); rear spar, lower, 3.5 x 0.8 cm (1.38 x 0.31 in.). The struts were attached to the widely separated spars and the cells thus formed were braced with steel wires. The lower wing had a slight dihedral. The wings were separable in the middle for transportation. They were held together by four screws. The longerons, which connected the tail with the wings, were about 40 cm (15.75 in.) apart, to allow room for the pilot. These longerons were braced by diagonal wires and were supported in front by two rods running to

*Translation from Chapter 3, "Der Gleit- und Segelflugzeugbau," by Alfred Gymnich. Published by Richard Carl Schmidt & Co., Berlin, 1925.

the upper ends of the rear inner struts. The rudder control cable passed over a pulley in front and was worked by the right hand. The stabilizing surfaces were doubly braced. At first the wings were covered on only one side, but were subsequently covered on the other side also. The spans of the several hang gliders built by Pelzner varied between 5.4 and 7 m (17.7 - 23 ft.), with a wing area of 14.0 - 16.5 m^2 (150.7 - 177.6 sq.ft.) and a weight of 9 - 19 kg (20 - 42 lb.). When taken apart, ready for shipment, the glider made a package 2.7 m (8.86 ft.) long, 1.4 m (4.59 ft.) high and about 50 cm (1.64 ft., or 19.7 in.) wide, so that, under certain conditions, it could be carried by railway as personal baggage. Under the most favorable conditions it had a lift-drag ratio of 1:6 in still air.

1921 Dresden School Biplane

This glider (Fig.2) was designed by H. Muttray, R. Seiferth and R. Spiess and built by the Dresden Aviation Club in less than two months. The upper wing had a span of 8 m (26.25 ft.); the lower wing, 6 m (19.68 ft.). Both wings had slight sweep backs. The upper wing was continuous and was partially supported by a cabane, while the lower wing was interrupted by the fuselage and had a dihedral angle. It lay about 25 cm (9.84 in.) above the ground, where it joined the fuselage and about 40 cm (15.75 in.) at the tips. The incidence or angle of setting of the lower wing

was somewhat greater than that of the upper wing. Each wing had two box spars 4 cm (1.57 in.) wide and 8-9 cm (2.36-3.54 in.) thick. The side walls were hollowed in. The leading edge of the medium-thick wings was covered with two layers of veneer glued together so as to give it good penetration. The lower wing was staggered slightly backward. The cabane struts were made by gluing the two halves together. They were streamlined, hollow and wound with linen. They were fastened to one another and to the fuselage without fittings. In fact, the only fittings on the whole glider were for the wing struts. The fuselage was approximately square and had a maximum cross section of 70 by 70 cm (27.56 in.). It was streamlined longitudinally, the stern being bent upward to protect the elevator. The fuselage was covered with fabric and tapered backward into a horizontal wedge. The elevator and rudder were operated by ropes. Banking was effected by warping the wings, although they were doped. The strong landing gear consisted of two laminated wood runners separated by the width of the fuselage. They were joined by two ash arches crosswise to the fuselage. In addition to the elasticity of the runners, blocks of rubber were employed as shock absorbers. Though of light weight and very flexible, this glider was very strong, as was demonstrated by its many landings on various kinds of ground, including newly plowed fields. The runners were attached to the fuselage only by gluing and binding. The empty weight of the glider was 70 kg (154.32 lb.), so that with a pilot weighing

70 kg, its wing loading was 8 kg/m^2 (1.64 lb./sq.ft.).

This glider proved to be especially well suited for school use. Many pilots were trained on it and flights up to ten minutes' duration and 3 km (1.86 mi.) were made with it. Several hundred flights were made without any particular damage. It participated successfully in the 1921-1923 Rhön contests, but was seriously damaged by a fall in the last contest.

1922 Darmstadt Glider "Edith"

This glider (Fig. 3) was designed by members of the Aviation Section of the Darmstadt Technical High School and also built by them with the exception of the fuselage. It was originally intended to be used only for school purposes, but made excellent soaring flights in the Rhön contests.

It was a high-wing monoplane with fuselage struts. It had a span of 12.6 m (41.34 ft.), a length of 5.5 m (18 ft.), and a height of 1.5 m (4.92 ft.). The chord was 1.35 m (4.43 ft.) and the wing area 15 m^2 (161.46 sq. ft.). The upper camber of the wing was 17 cm (6.7 in.) and was the same throughout. The wing was divided in the middle and had two spars. At a distance of 2 m (6.56 ft.) from the middle in each direction it was braced to the bottom of the fuselage by a pair of parallel struts. In order to obtain good penetration, the leading edge was covered with plywood. The wing had both main and intermediate ribs, the former being 30 cm (11.81 in.) apart. The spars were braced

against torsional stresses by diagonal struts. Banking was effected by narrow rectangular ailerons, which were hinged to the rear spar. The fuselage was 5.15 m (16.9 ft.) long. It had strong bulkheads, without diagonal brace-wires, and was covered with plywood. At the pilot's seat it had a five-cornered cross section, which changed farther back to a rectangular shape and then tapered out to a horizontal wedge at the stern. The landing gear originally consisted of two ash runners extending 20 cm (7.87 in.) below the fuselage, but these were subsequently replaced by one central runner. The 1.6 m^2 (17.22 sq.ft.) elevator had a damping surface (stabilizer) of 2.2 m^2 (23.68 sq.ft.). The rudder had an area of 0.4 m^2 (4.31 sq.ft.) and the fin 0.45 m^2 (4.84 sq.ft.). The total weight of the glider was 90 kg (198.4 lb.). The wing loading was about 11 kg/m^2 (2.25 lb./sq.ft.)

Excellent results were obtained in the 1922-1923 Rhön contests. It was found that the glider was exceptionally well qualified for static soaring. In the 1923 contest Spiess attained the greatest flight duration of 1 hr. 17 min., at one time remaining motionless over the slope for 15 min.

1923 Darmstadt Glider "Konsul"

The "Konsul" was designed by Botsch and Spiess, and built by the "Bahnbedarf" Company of Darmstadt (Fig. 4). The design was based on two different principles. On the one hand, it was sought to utilize the variations in the slope of the wind (Knoller-Betz effect)

and, on the other hand, to develop static soaring flight with especial attention to distance flight. This glider was an overhung high-wing monoplane of 18.7 m (61.35 ft.) span and 1.2 m (3.94 ft.) chord, corresponding to an aspect ratio of about 15. In spite of its great span, it had no struts and only one wing spar. The latter was box-shaped in the 8 m (26.25 ft.) central section and I-shaped in the outer sections. The leading edge, from the top of the spar around to its bottom, was covered with plywood. The spar junctions were made with sleeve couplings according to the Junkers system, the false spars being connected by cone-bolts. The profile used was the Messerschmidt "S 13" (Göttingen 535). It tapered rapidly at the outer ends and was kept symmetrical by reducing the angle of incidence or setting, in order to obtain a perfect warping effect and more favorable lift distribution. The ailerons were so connected with the steering gear that, when the rudder was not deflected, they operated in the usual manner. In steering to the right, however, any warping maneuver of the control stick actuated the right aileron more than the left one. In steering to the left, this action was reversed. With the enormous span, such a reinforcement of the rudder by the ailerons seemed very opportune. The fish-shaped plywood fuselage had sharp edges, both above and below, which produced the necessary keel effect. The central runner was covered with fabric, carefully protected against shocks by winding with rubber cable. The wing area was 22 m^2 (236.81 sq.ft.). The estimated weight of 130 kg

(287 lb.) was apparently somewhat overrated, which would partially explain the unexpectedly high speed of the glider. The best lift-drag ratio was 1:21.4 at 14.8 m/s (48.56 ft./sec.) flight speed. On September 29, 1923, Botsch made, on the Konsul, a new world's distance record of 18.9 km (11.74 mi.).

1921-1922 Hannover Glider "Vampyr"

At the suggestion of Professor A. Pröll and Engineer H. Dorner, this glider (Fig. 5) was designed by the students Martens, Hentzen and Blume from a rough sketch by Dr. G. Madelung, and was built by the "Hannoversche Waggonfabrik." It was an overhung high-wing monoplane of 12.6 m (41.34 ft.) span by 1.45 m (4.76 ft.) chord and had a wing area of about 16 m^2 (172.22 sq.ft.). Its mean aspect ratio was 10. The wing consisted of a middle section of 6.6 m (21.65 ft.) span and two end sections of 3 m (9.84 ft.) each. The Göttingen profile 441 was used, which had, in the central section of the wing, a maximum upper camber of 25 cm (9.84 in.). The end sections were tapered. The angle of incidence (or wing setting) to the upper edge of the fuselage was zero. It was on the Vampyr that the method, subsequently adopted on all high-grade gliders, of constructing the wing with a single spar and covering the leading edge with plywood, was first used. The spar was located in the line of mean pressure of the wing and took the form of an I-girder with pine flanges and a plywood web. The ribs, in the lattice-girder construction

method, were made extremely light. Nevertheless, each rib could stand a load of 40 kg (88.2 lb.) without breaking. The main ribs were placed 50 cm (19.69 in.) apart, with one or more intermediate ribs, according to the magnitude of the air forces. From the spar back, the wing was covered with light fabric, well doped and varnished. The wing was attached to the fuselage at three points. The main forward fitting united the wing spar to the main fuselage bulkhead by means of a bolt. Both rear fittings rested on the ends of two reinforced rods, which held the rigid front part of the wing and lay on the upper fuselage longerons. Each rod was in turn fastened by a bolt to a fitting secured to a fuselage bulkhead. The strong fittings were easily accessible through traps, to facilitate quick assembling, and were so secured that, after loosening the bolts, the wing could be shifted so as to remedy any nose- or tail-heaviness. On each side of the fuselage the wing spar was connected with the main bulkhead by a short strong strut, in order to protect the wing fittings, which covered only a narrow base, from possible excessive stresses. The end sections of the wing were likewise joined to the middle section at three points. The flanges and web of the wing spar were each held by a fitting which transmitted the bending and lateral stresses to a bolt situated at the height of the flange. A second fitting, with a bolt on the false spar, transmitted the frontal pressure and shared the torsional stresses with the fitting of the main spar. These junc-

tions were also easily accessible. In the first model of the Vampyr in 1921, the trapezoidal end sections of the wings had the usual ailerons. In the 1922 model, the end sections were rectangular with a slight sweep back. The ailerons were omitted and warping was effected by means of an aluminum tube with lateral arms and the introduction of flexible rods into the wing. The balls used to protect the wing tips in the 1921 model were likewise omitted. Curving flight was facilitated by the elimination of the inertia moments due to these balls. The fuselage showed a peculiar type of construction, which proved very successful and which was subsequently much imitated. Rectangular in its main dimensions, the portion of the fuselage behind the pilot's seat was slanted sharply upward so as to obtain a greater angle of attack in starting and in landing and tapered out into a horizontal wedge. The front portion of the fuselage was slanted downward. It consisted of strong longitudinal ash strips and transverse bulkheads, triangular at the top, forming a streamlined framework, which was covered with plywood and gradually passed over into the rectangular stern. For all its strength and rigidity, the fuselage weighed only about 25 kg (55 lb.). The undamped elevator, whose axis of rotation lay in the central line of pressure, was mounted on the horizontal rear edge of the fuselage. It was operated by a rod connected with the normal control stick. The area of the elevator was 1.875 m^2 (20.18 sq. ft.). The rudder, which had an area of 0.48 m^2 (5.17 sq.ft.),

was operated by pedals and cables. It formed a continuation of the fin, which had an area of 0.8 m² (8.61 sq.ft.). The landing gear also differed from the customary one. It consisted of three balls, similar to footballs, with their axles inside the fuselage. One ball was under the nose and the other two slightly behind the center of gravity.

The Vampyr is known especially for the hour-long flights of Martens and Hentzen in the 1922 Rhön contest. In the 1923 contest this excellent glider was unfortunately destroyed through the carelessness of a new pilot.

1922 Hannover Glider "Greif"

For continuing the soaring-flight research of the Aviation Section of the Hannover Technical High School, begun with the Vampyr, the "Greif" was designed by Hentzen and Martens (Fig. 6), again with the friendly cooperation of Professor A. Pröll and H. Dorner. The construction was likewise again undertaken by the "Hannoversche Waggonfabrik." It was sought to effect a considerable diminution in weight with a smaller span, in order to obtain a more maneuverable glider. Especial importance was attached to reducing the air resistance. This overhung monoplane therefore exhibited especially fine lines. The wing was made in three sections. The central section, however, had a span of only 1.3 m (4.27 ft.) and was firmly secured to the fuselage as a cabane. The trapezoidal wings were each 5.15 m (16.9 ft.), mak-

ing the total span 11.6 m (38.06 ft.). The wing chord diminished from a maximum of 1.8 m (5.91 ft.) to 1 m (3.28 ft.) at the tips, thus making a wing area of 15 m^2 (161.46 sq.ft.). At the cabane the upper camber was 28 cm (11.02 in.) and decreased uniformly. The wing had a single spar combined with a rigid plywood leading edge. The spar was an ordinary lattice girder with a plywood web. The flanges and lattices, which were especially stressed in landing, were reinforced. The main ribs were 40 cm (15.75 in.) apart but light intermediate ribs were added to the front part of the wing. The plywood tubes which, together with the spar, absorbed the torsional stresses, terminated at about the center of each end section. Hence the wing tips were not torsion-proof. In each wing tip the torsional forces were absorbed by a duralumin tube parallel to the spar and firmly bound to the end of the latter. It was possible to rotate this tube and thus warp the wing tips. This method of warping proved to be very effective. The lower edges of the wing tips were protected by sheet duralumin. The wings were connected with the cabane, the same as on the Vampyr. The aileron-control tubes were connected by a claw coupling, which enabled the safe transmission of the stresses. The fuselage was spindle-shaped. The cabane had a cutaway for the pilot's head, the rest of the pilot being fully enclosed in the fuselage. The fuselage bulkheads were firmly held by four light longerons, since the stresses were exclusively absorbed and transmitted by the plywood covering. The wing spar was firm-

ly attached to the main bulkhead. An auxiliary spar of the cabane likewise transmitted the stresses to a strong bulkhead. From the spars, streamlined steel bands provided for the stress transmission corresponding to every case of loading. The landing gear consisted of only two tandem balls. The undamped elevator, of 1.8 m² (19.38 sq.ft.) area, was actuated by a rod. The rudder was actuated by cables in the usual manner. The rudder had an area of 0.5 m² (5.38 sq.ft.); the fin, 0.6 m² (6.46 sq.ft.).

In the 1921 and 1922 Rhön contests numerous flights were made, including three of 45 minutes each by Martens, Hentzen and Koch, but the Greif did not equal the Vampyr, notwithstanding its better aerodynamic design. This fact is ascribable to the poor aspect ratio and to the complete enclosure of the pilot, whereby the sensing of the air flow was rendered more difficult.

1923 Hannover Glider "H6" ("Pelikan")

The glider (Fig. 7) was designed by the students Günther, Martens and Meyer, under the supervision of Professor A. Pröll of the Aviation Section of the Hannover Technical High School. It was built by the "Hannoversche Waggonfabrik." It was a remarkable development of the Vampyr and Greif but, unlike these, had ailerons for the lateral control. The wing had a single spar and was made in three sections. Its front portion was made into a torsion-proof tube in the usual manner by means of a plywood covering. The plywood fuselage had an oval cross section and

tapered to a horizontal wedge. As in the Greif, the landing gear consisted of two tandem balls. The ailerons were very narrow and long. The elevator and rudder were rectangular. There was no fin nor stabilizer. This glider had the following characteristics:

Span	15.0 m	(49.21 ft.)
Length	5.26 m	(17.26 ")
Wing area	15.00 m^2	(161.46 sq.ft.)
Wing loading	9.7 kg/m^2	(1.99 lb./sq.ft.)
Weight of fuselage	25.5 kg	(56.2 lb.)
Wt. of central wing section	20.0 kg	(44.1 ")
Wt. of each end section of wing	13.5 "	(27.56 ")
Wt. of elevator	3.4 "	(7.5 ")
Wt. of rudder	1.1 "	(2.4 ")
Total weight	75.0 "	(165.3 ")

Especially remarkable were the sinking speed of only

0.447 m/s (1.467 ft./sec.)

and the gliding angle of 28.8 degrees.

The Pelikan was not finished in time for the 1923 Rhön contest. In the 1924 Rositten soaring-flight contest, under the piloting of Koch, it made a flight of 30 minutes above a comparatively small dune.

1923 Glider "Der Dessauer"

This glider (Fig. 8) was designed and built by members of the Dessau Aviation Club with the backing of the "Junkerswerke" of Dessau. The wing was made with a single spar and a torsion-proof plywood leading edge and was divided in the middle. The lower flanges of the two sections of the wing spar were joined at this point and were secured to the fuselage by an adjustable fitting for the purpose of trimming the aircraft. The upper flanges butted together and were thus firmly held by compression during flight. For constructional reasons the wing halves were given a uniform cross section (Göttingen profile 289), while the thickness was gradually reduced in the outer portions. The fuselage tapered to the elevator, its main bulkhead being pentagonal. The fuselage was built without diagonal bracing, since the plywood covering distributed the stresses. The landing gear consisted of a central runner with an air-cushion shock absorber, the same as was first used by the "Geheimrat." On each side of the fuselage the wing was attached to the main bulkhead by a short strong strut. In order to soften the landing shock, rubber pads were built into the struts, which yielded about 5 mm (0.2 in.) under compression, but remained perfectly rigid under tension. This glider had an adjustable stabilizer which, like the fin, was entirely covered with plywood. The ailerons and rudder were quite large, while the stabilizer was comparatively small. The aileron controls were constructed on the principle

of differential steering, i.e., a given downward deflection of one aileron corresponded to a greater upward deflection of the other aileron and vice versa. The steering controls were actuated by rods and bent levers. The chief characteristics were as follows:

Span	12.8 m	(42 ft.)
Chord	1.28 "	(4.2 ft.)
Aspect ratio	10.6	
Length	5.7 "	(18.7 ")
Height	1.35 "	(4.43 ")
Wing area	15.5 m^2	(166.84 sq.ft.)
Stabilizer	0.95 "	(10.23 ")
Elevator	1.5 "	(16.15 ")
Fin	0.44 "	(4.74 ")
Rudder	1.3 "	(14.00 ")
Ailerons (each)	1.66 "	(17.87 ")
Weight, empty	115.0 kg	(253.5 lb.)
Wing loading	11.3 kg/m^2	(2.31 lb./sq.ft.)

In the Rhön contest excellent results were obtained by the pilot Thompson. In this glider the inertia moments were eliminated as much as possible by a good distribution of the load, thus enabling excellent curving flight. On the next to the last flight day, the wings broke just above the ground, apparently due to the resonance vibrations, which were favored by the rubber buffers built into the side struts, and the glider was dashed to pieces.

1922 Darmstadt Glider "Geheimrat"

This overhung high-wing monoplane was designed by Nicolaus and Hoffmann and built by the Darmstadt "Bahnbedarf" Company (Fig. 9). It was owned by the Aviation Section of the Darmstadt Technical High School. It had a span of 12.1 m (39.7 ft.); length 5.45 m (17.88 ft.); chord 1.41 m (4.63 ft.); wing area 14.3 m^2 (153.92 sq.ft.). The wing was made in three sections. The central section had a span of 6 m (19.68 ft.) and a uniform profile with an upper camber of 24 cm (9.45 in.). The trapezoidal end sections each had a span of 2.75 m (9.02 ft.) and tapered uniformly. The wing had a main and auxiliary spar and could be rotated around the former by means of the control stick and push-rods. The leading edge was covered with plywood. The lateral control was exercised in the usual way by ailerons. The fuselage was 4.92 m (16.14 ft.) long and had a rectangular cross section. It was streamlined and ran into a horizontal wedge. The landing gear consisted of two low runners at the outer edges of the fuselage. The space between the fuselage and runners was occupied by an air cushion protected by sheet duralumin. The balanced undamped elevator had an area of 1.4 m^2 (15.07 sq.ft.) and was operated by a lever beside the pilot's seat. The elevator could be given the best angle of attack for the prevailing wind conditions and then locked in position during the flight. In front of the 0.35 m^2 (3.77 sq.ft.) rudder, there was a fin of 0.47 m^2

(5.06 sq.ft.). The wing weighed 43 kg (94.8 lb.); the fuselage 28 kg (61.7 lb.). The wing loading was 11.5 kg/m (2.36 lb./sq.ft.).

This glider accomplished excellent results in the 1922 and 1923 Rhön contests. In 1922 Hackmack flew 1.5 hr. and reached an altitude of 320 m (1050 ft.) above his starting point. In 1923 Thomas won the first prizes for the greatest single and total flight duration.

1922 Dresden Monoplane Glider

This wing-steered, strutted, high-wing monoplane (Fig. 10) was designed by H. Muttray and R. Seiferth of Dresden, and was built by members of the Dresden Aviation Club. It had a span of 12.2 m (40 ft.); chord 1.35 m (4.43 ft.); wing area 15.5 m^2 (166.84 sq.ft.); aspect ratio, 9.5. The wing was made in four sections, the two-meter end sections being removed only for railroad transportation, to enable it to be loaded into an ordinary closed car. The wing had a box spar with internal diagonal bracing and open-work side walls. The leading edge of the wing was covered with plywood. The spar was computed for a safety factor of 7. Taking into consideration the centers of gravity and pressure of the wing, the position of the axis of rotation of the wing was so chosen that no stresses were developed in the control stick during normal flight. The wing was jointed to the fuselage by a special form of cabane. The wing (Göttingen profile 441) tapered only near the tips, where it changed into a

streamlined profile with zero incidence. The wing tips were pointed, so as to prevent the formation of eddies or vortices. Each half of the wing was supported by two struts which met at the wing. The wings could therefore be rotated in unison for vertical steering and oppositely for banking. The fuselage had a maximum rectangular cross section of 60 x 70 cm (23.6 x 27.6 in. and tapered to a horizontal wedge for attaching the balanced undamped elevator of 1.9 m^2 (20.45 sq.ft.) area. The 0.55 m^2 (5.92 sq.ft.) rudder followed a fin of 0.66 m^2 (7.1 sq.ft.). The rudder was actuated by a special lever in the cockpit. Normally, however, the elevator was not operated during flight. In the 1923 contest the wings and elevator were so coupled that an increase in the angle of attack of the wings produced a corresponding deflection of the elevator in the same direction. This simultaneous deflection of the wings and elevator was intended to enable the fuselage to retain its normal position, so as to avoid longitudinal inertia moments. The bow of the fuselage was shaped by ash strips and covered with plywood. The landing gear was the same as on the Dresden biplane. The weights of the monoplane were as follows:

Wing	55.2 kg	(121.7 lb.)
Fuselage	45.1 "	(99.4 ")
Rudder	3.6 "	(7.94 ")
Elevator	4.6 "	(10.14 ")
4 steel tube struts	10.0 "	(22.05 ")

Weight, empty 75 kg (165.3 lb.)

Including 75 kg (165.3 lb.) for the weight of the pilot, the

Wing loading was 12.5 kg/m^2 (2.56 lb./sq.ft.)

Numerous successful flights were made over the landing field of the Dresden Aviation Club in the "Erzgebirge" (Erz mountains). The lift-drag ratio was found to be 1:14.6 in still air. In the 1923 Rhön contest, one wing broke about 200 m (656 ft.) above the valley and the glider went into a spin and crashed, thereby losing its elevator also. Through a lucky chance the pilot Muttray escaped with a broken leg and a few abrasions. The wing-break, in spite of the sevenfold safety factory, was explained by the presence of an unnoticed internal defect produced by a previous fall.

1923 Messerschmitt Glider "S 13"

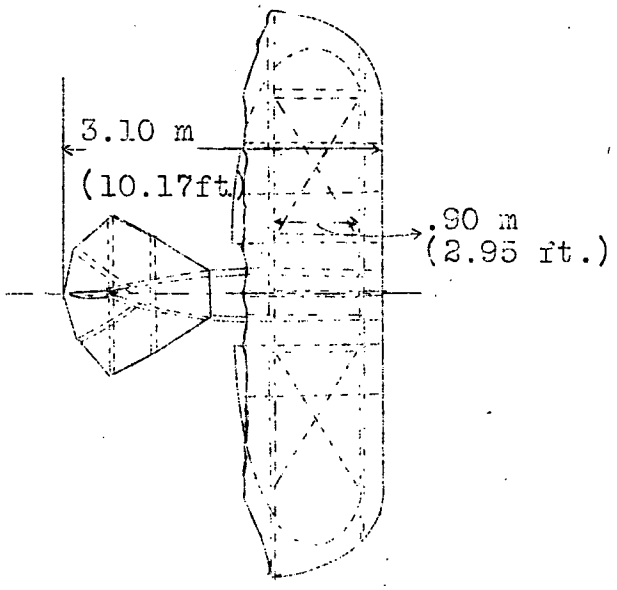
Up to the "S 12" Harth and Messerschmitt had developed their gliders together. The "S 13" was, however, designed and built by Messerschmitt alone (Fig. 11). He abandoned the previous two-stick system and installed only one control stick. The stabilizer was made adjustable by means of a lever which could be locked in position. The wing warping was effected by a strong steel torsion tube mounted parallel to the wing spar. The span was 14 m (45.93 ft.) and the length 4.9 m (16.08 ft.). The wing was made in three sections and had a single spar, with alternate main and auxiliary ribs. The fuselage was rectangular in cross section and streamlined longitudinally. For landing gear, it

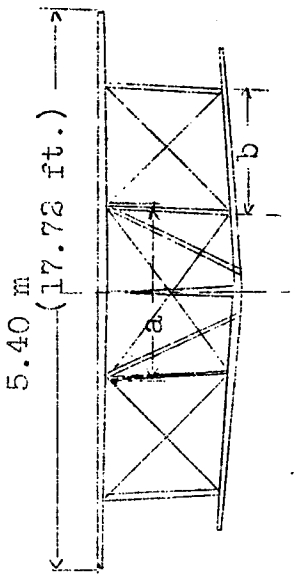
had a long central spring runner. The wing was attached to each side of the fuselage by a short strut. The wing warping was parallel for one-third of the wing and differential for the remaining two-thirds. The balanced undamped elevator was likewise operated by a rod, cables being employed only for the rudder. Only the central section of the wing was doped, so as not to interfere with the warping.

With the "S 14," which differed but slightly from the "S 13," Hacknack made, in the 1923 Rhön soaring-flight contest, a "storm" soaring flight over land and attained a maximum altitude of 303 m (994 ft.). Another glider of this type, equipped with a 500 cm^3 (30.51 cu.in.) Douglas engine, on June 19, 1924, remained in the air at Bamberg for 43 minutes and reached an altitude of 600 m (1968 ft.).*

Translation by Dwight M. Miner,
National Advisory Committee
for Aeronautics.

*This Memorandum will be followed by Technical Memorandum No. 434, "Glider Construction and Design," by the same author.





1.80 m
a = (5.91 ft.)
1.20 m
b = (3.94 ft.)

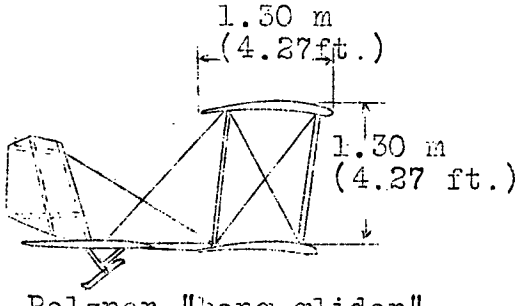


Fig.1 Pelzner "hang-glider".

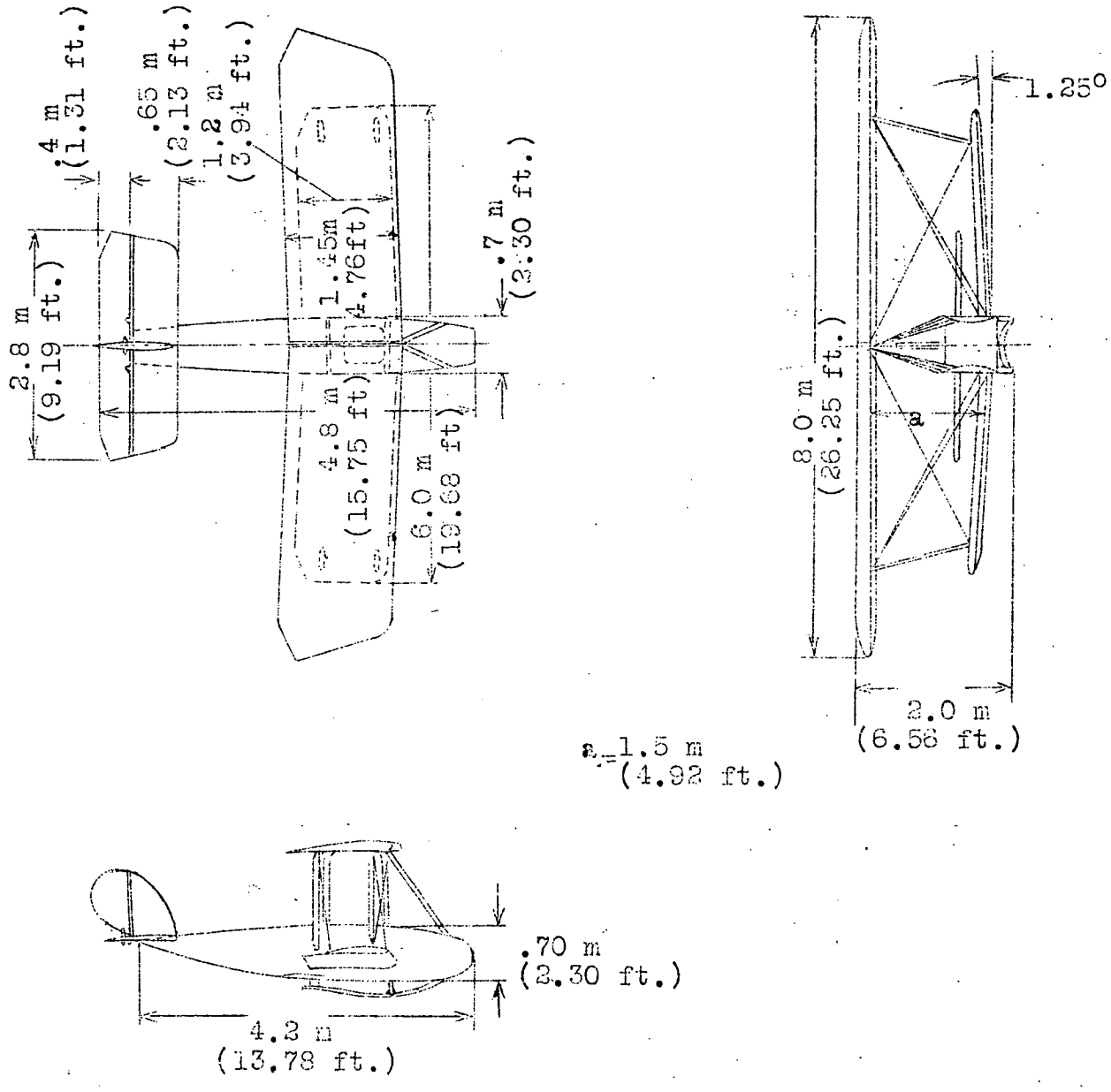


Fig.2 Dresden biplane glider

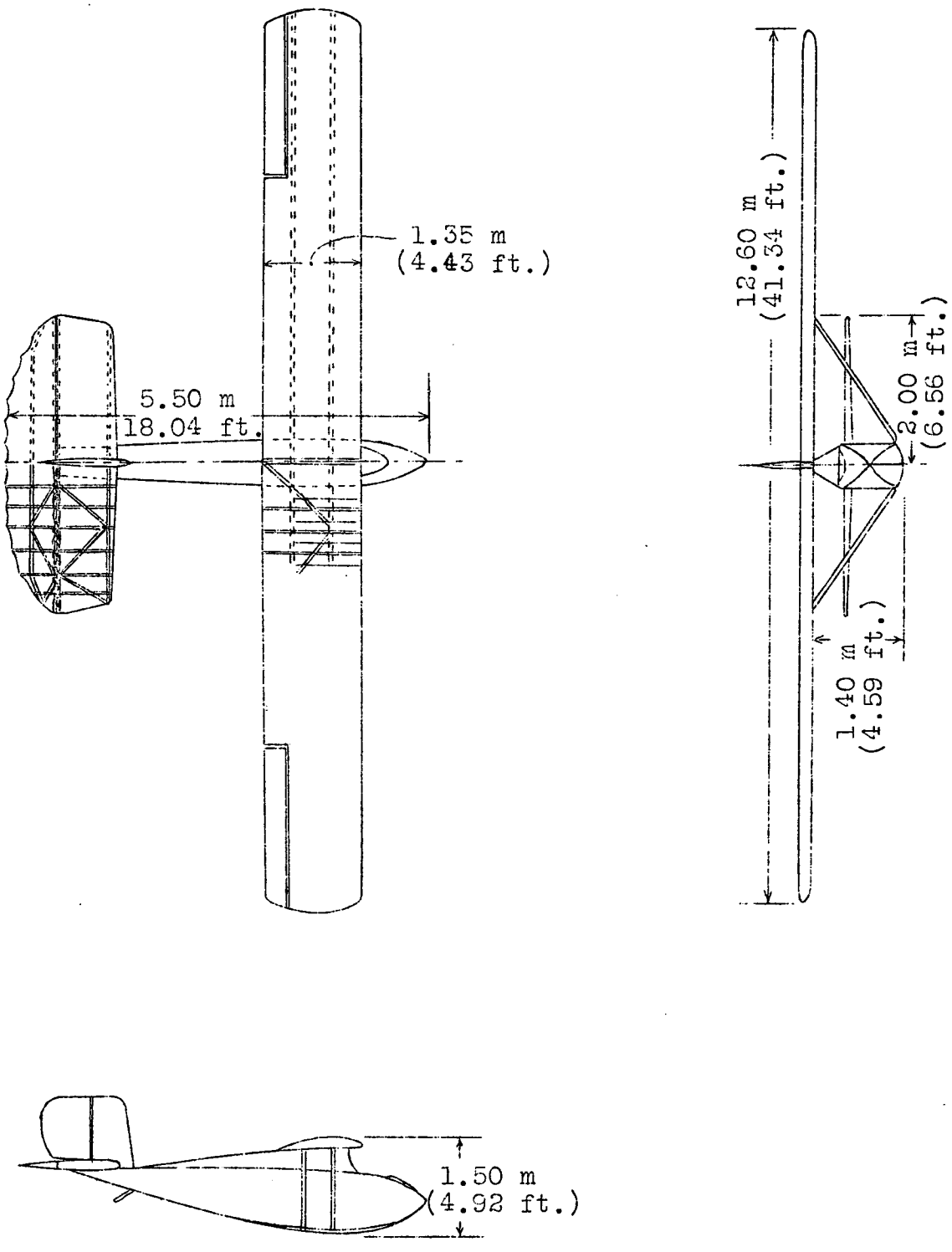


Fig.3 Darmstadt glider "Edith"

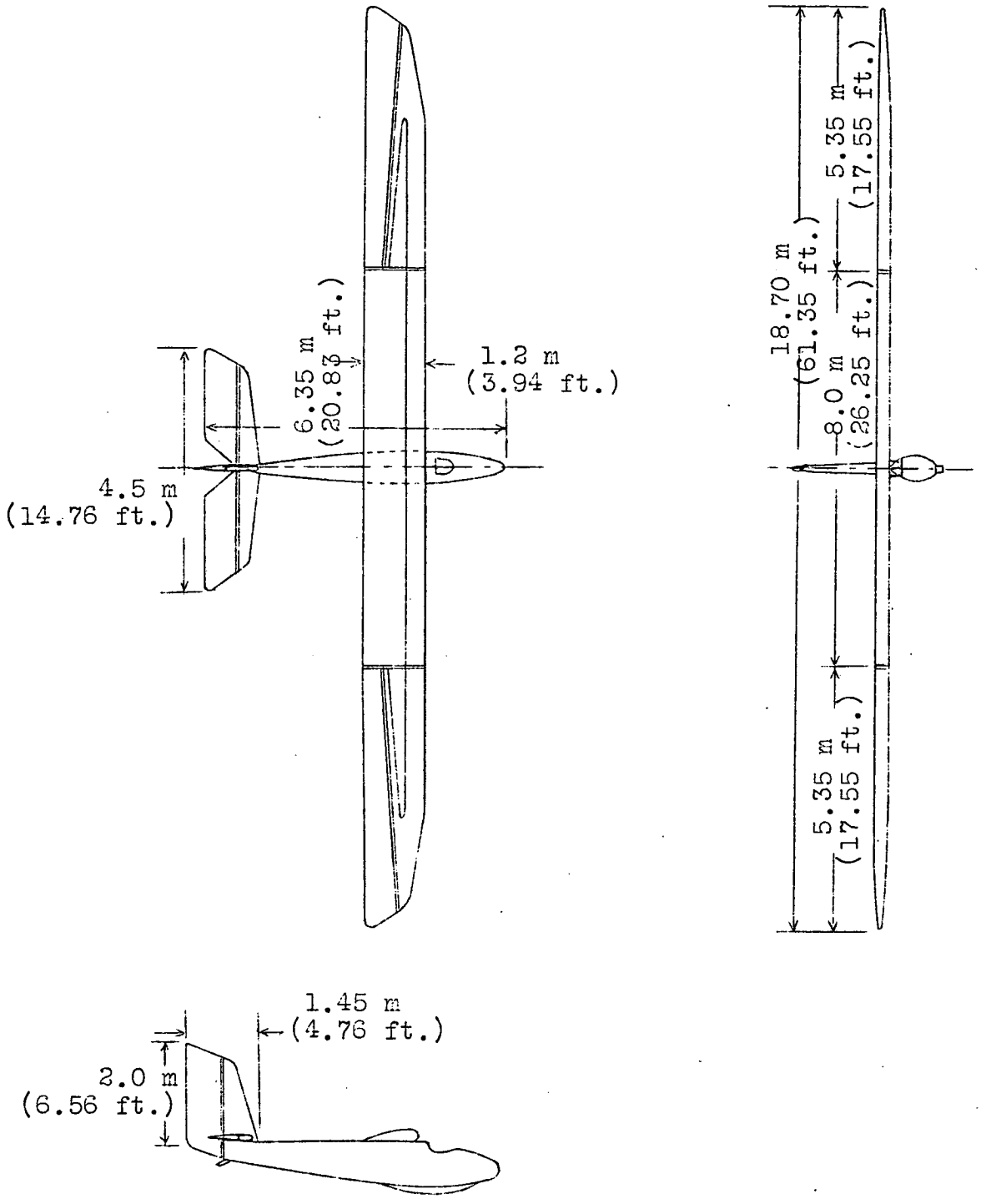


Fig.4 Darmstadt glider "Konsul".

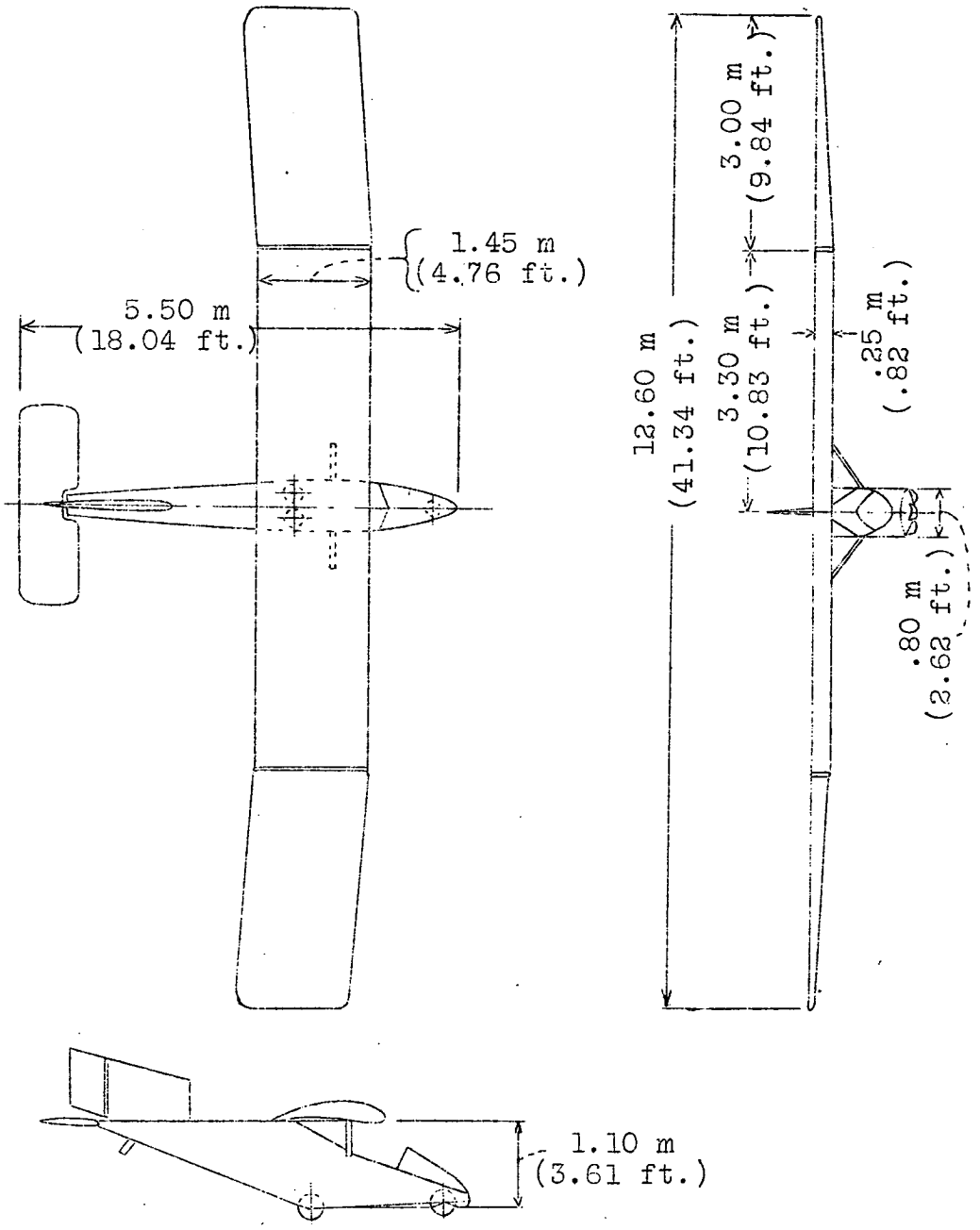


Fig.5 Hannover glider "Vampyr".

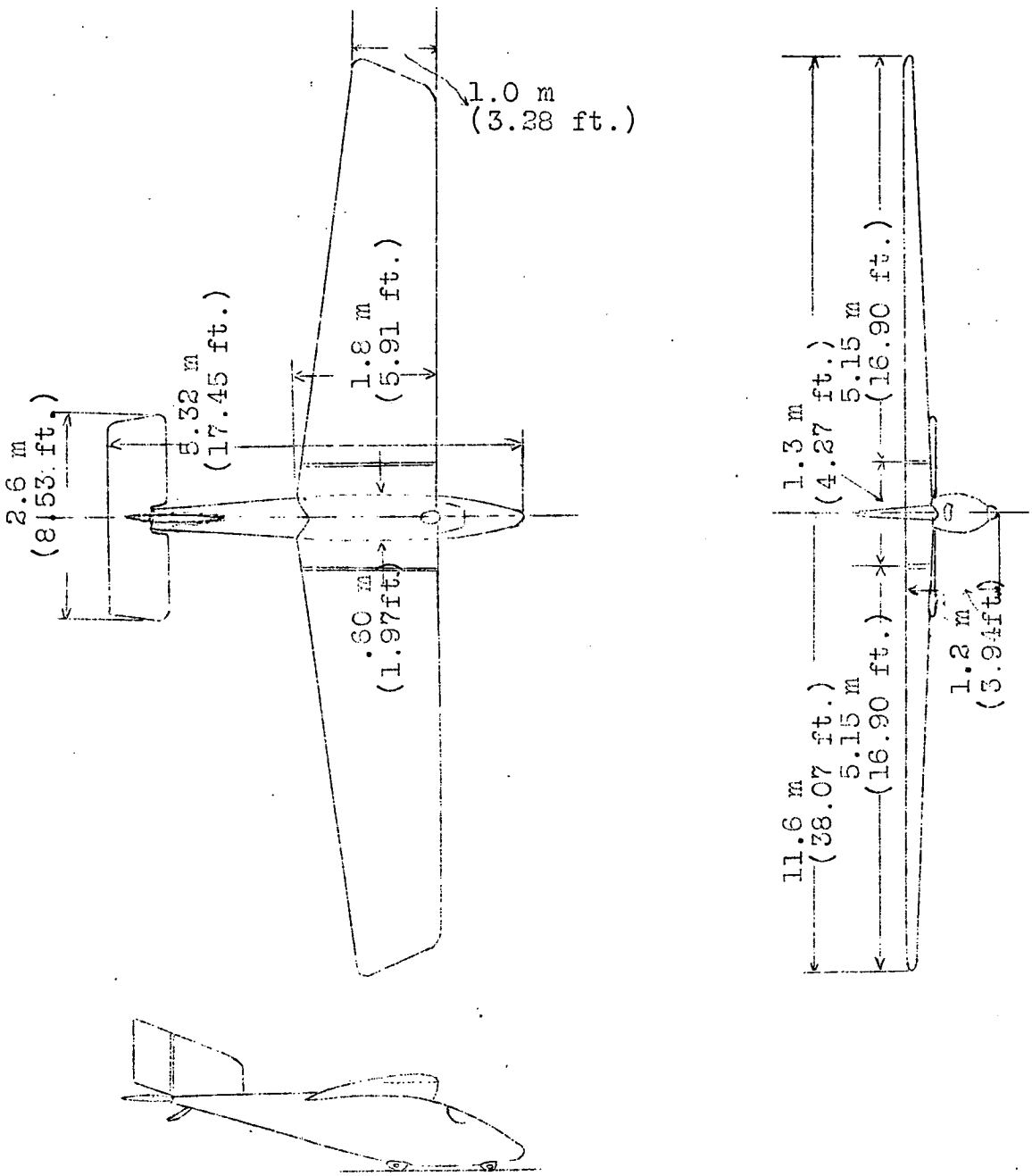


Fig.6 Hannover glider "Greif".

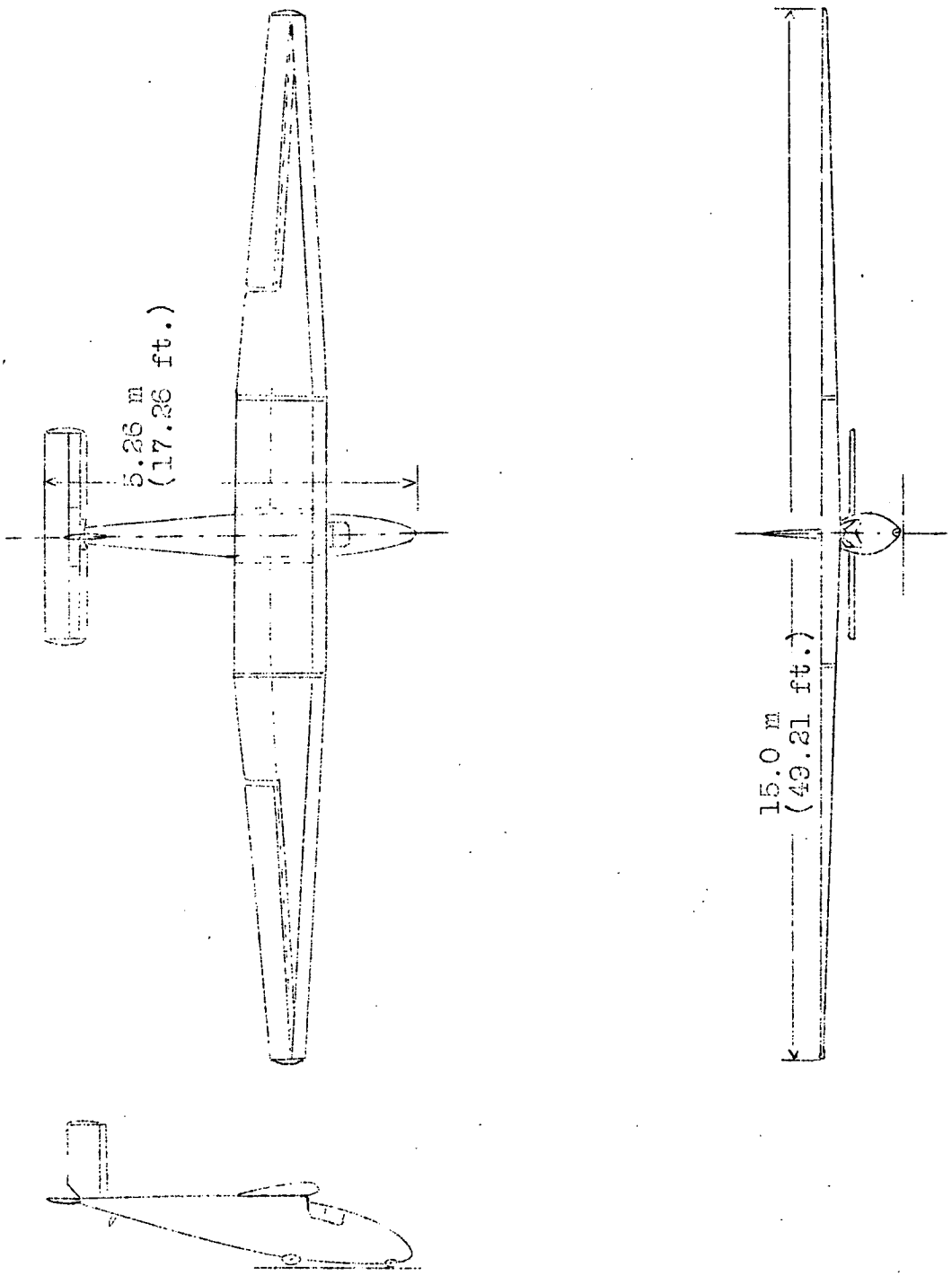


Fig.7 Hannover glider H6 "Pelikan".

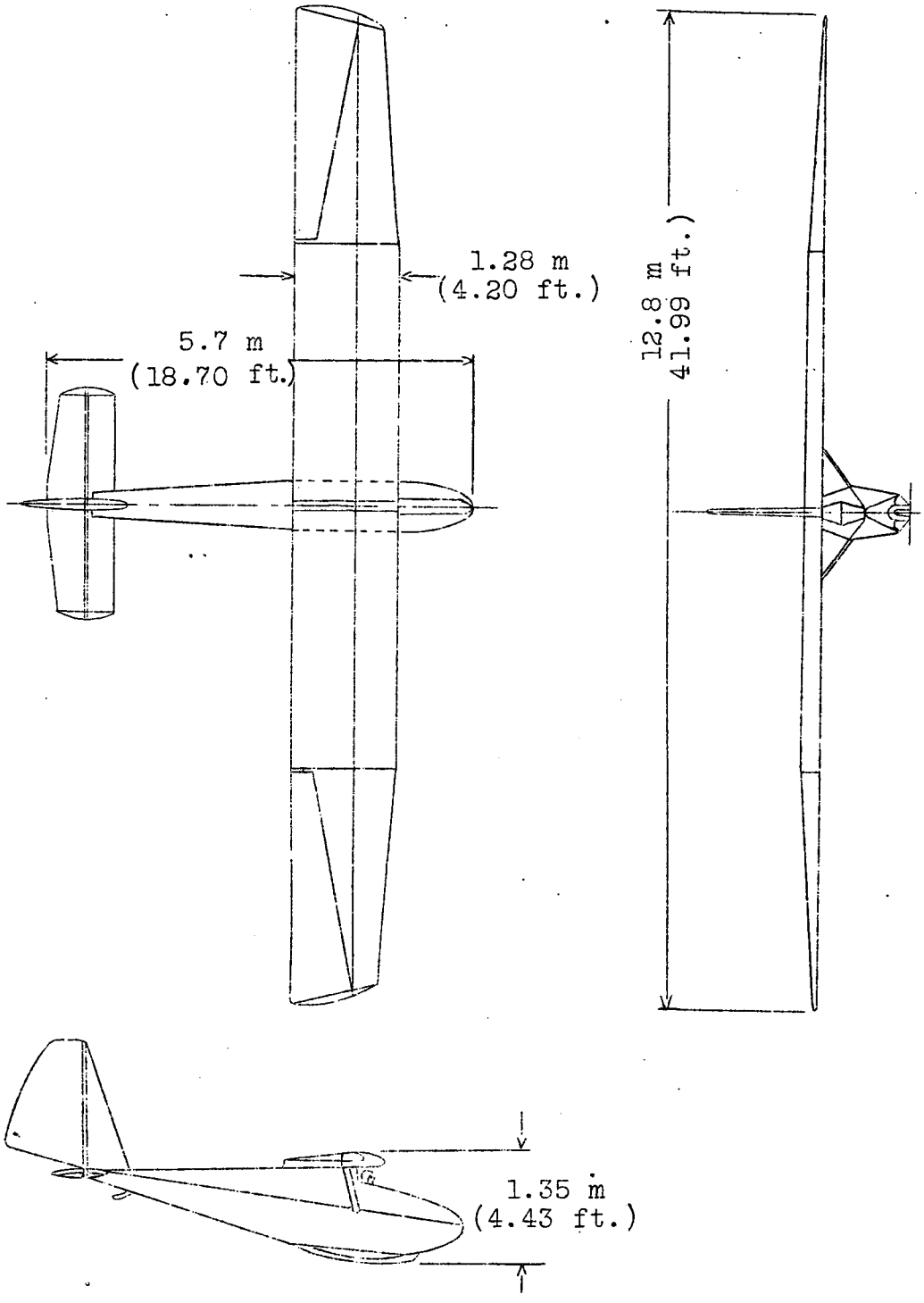
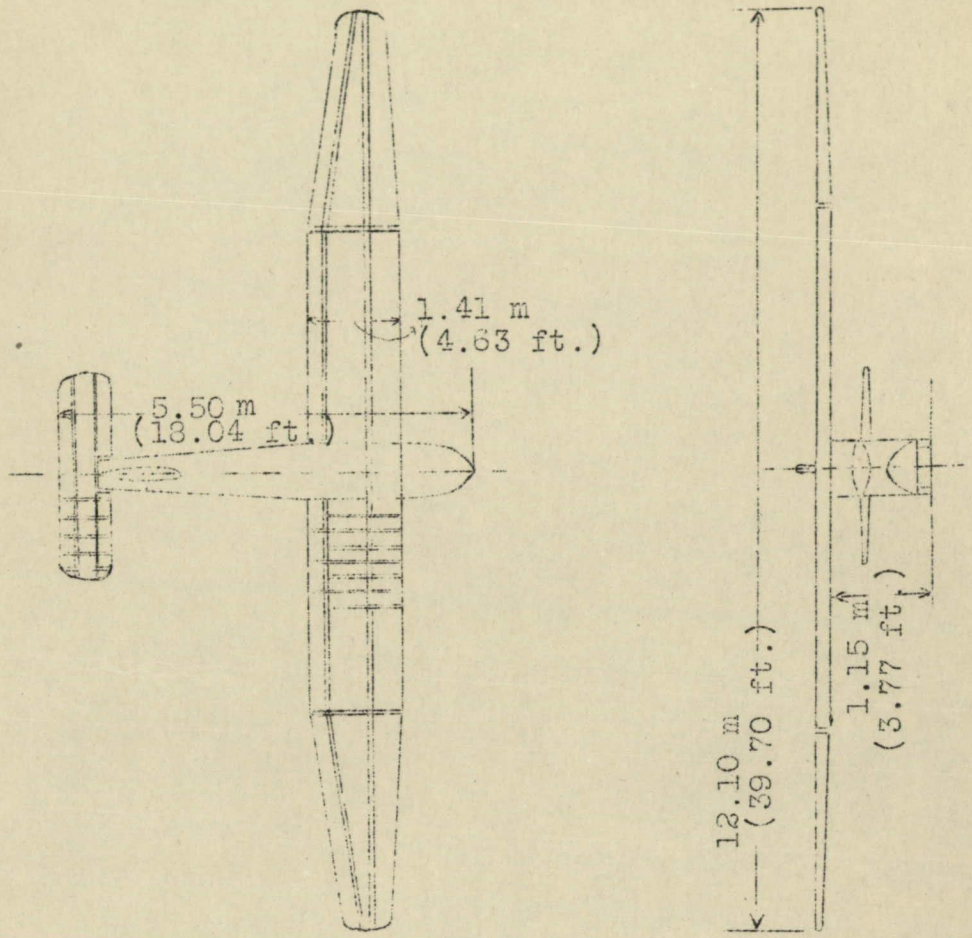


Fig.8 Glider "Der Dessauer".



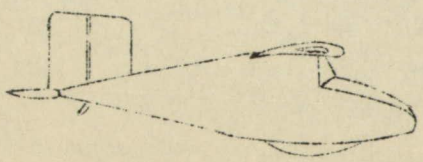


Fig.9 Darmstadt glider "Geheimrat".

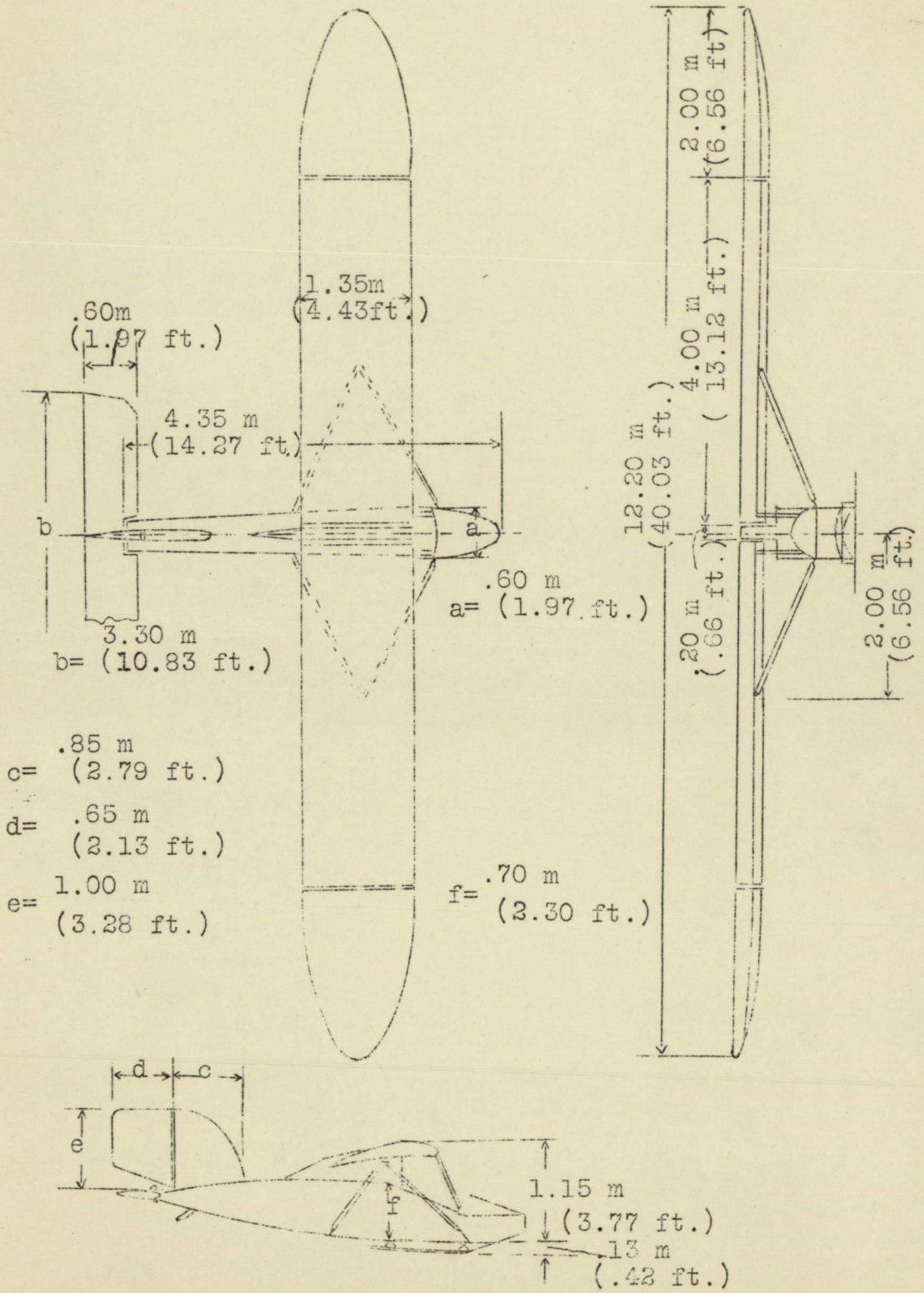


Fig.10 Dresden monoplane glider.

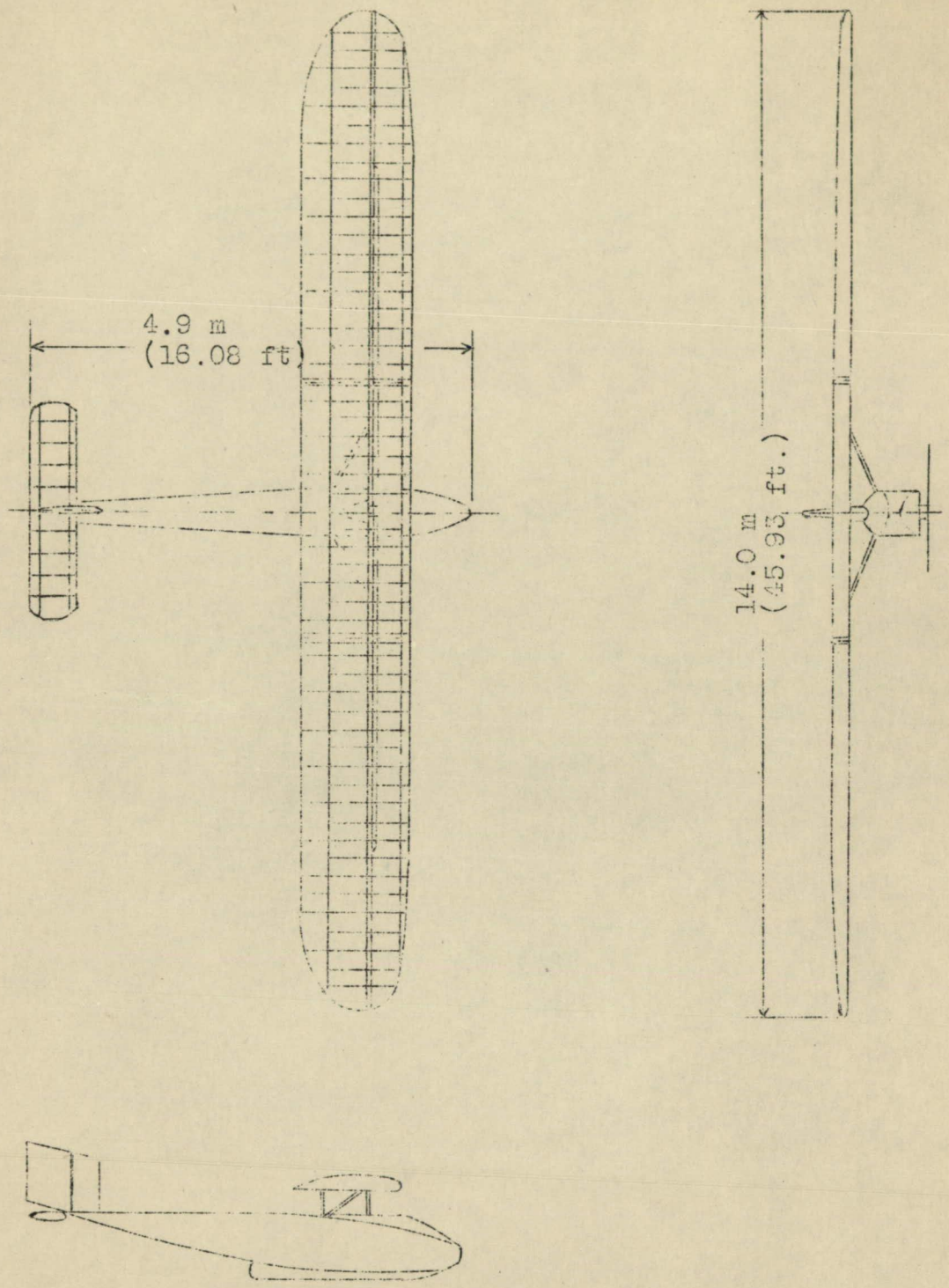


Fig.11 Gilder "Messerschmitt" S13.