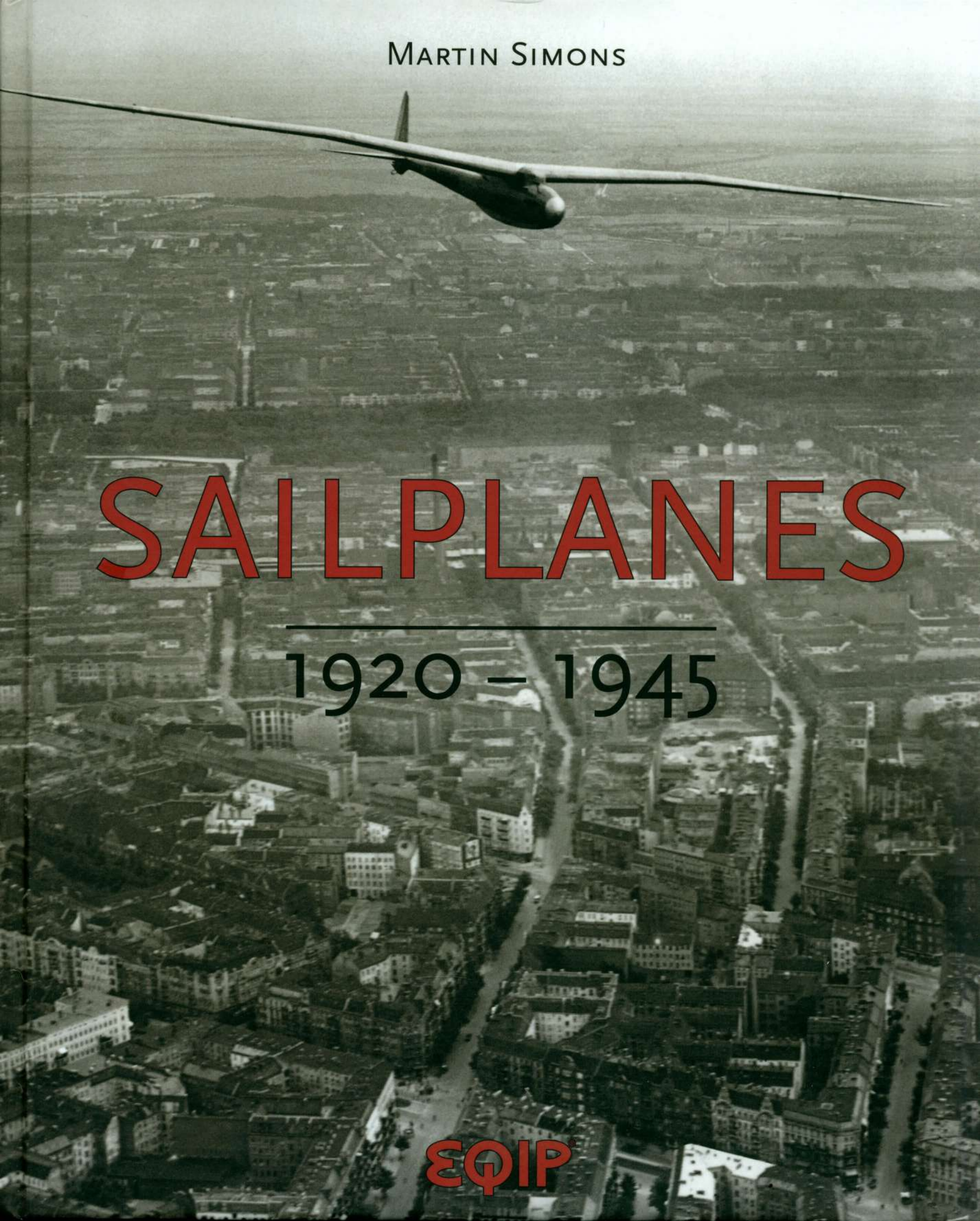
MARTIN SIMONS



SAILPLANES

1920 – 1945

EQIP

„Their slim shapes are smooth to touch and slippery like ice. Their rounded backs catch the light and reflect it like polished glass. Their curves are symmetrical, continuous, and blended into one another as geometrical designs which are happily married. When their wings are against the sky they are transparent, and you can see their ribs against the light beyond. No bird has better-shaped wings, no wings were ever spread in such a challenge. To see them is to know that they can fly. It is clear that they belong to the wind and the sky and that they are part of it as much as the clouds of a summer day."

Terence Horsley, Soaring Flight, 1944

2nd Revised Edition, 2006

The publishers seek unusual photographs and documents from the early days of aviation. We would like to hear from anyone owning such materials, who would wish to have them published.

EQIP Werbung & Verlag GmbH
Hauptstr. 276 · D-53639 Königswinter · Germany
Telephone +49.2223.917070 · Telefax: +49.2223.917010
Website: www.eqip.de · e-mail: eqip@eqip.de

Printed in Czech Republic by Graspo CZ, a. s. Zlin
ISBN 3-9806773-4-6

Martin Simons

SAILPLANES

1920 - 1945

EQIP®

Contents

Preface 6
Introduction 7

Chapter 1: 8 **The Discovery of Soaring**
8 Pelzner
10 Schwatze Düvel
13 Weltensegler
15 Vampyr
17 Harth & Messerschmitt
21 Anthony Fokker's biplane
21 Peyret Tandem

Chapter 2: 25 **The Darmstadt School of Design**
26 D - 7 Margarete
26 D - 9 Konsul
30 Württemberg
30 D - 17 Darmstadt and 'Chanute'
34 D - 19 Darmstadt 2
34 Musterle

Chapter 3: 38 **Learning to fly**
38 Djävlar Anamma (Hols der Teufel)
40 Zögling and Prüfling
44 Dagling
47 Grüne Post
47 SG - 38

Chapter 4: 50 **The Rhön Ghost**
50 Storch
54 Storch VIII Marabu
54 Delta
54 Falke

Chapter 5: 58 **Lippisch, Georgii and Thermal Soaring**
59 Professor
62 Wien
65 Fafnir
70 Obs
70 Fafnir 2 Sao Paulo

Chapter 6: 73 **Dittmar and the Condors**
73 Condor
76 Condor 2 & 3

Chapter 7: 78 **The very large and the very small**
79 Ku - 3 Kakadu
81 Ku - 4 Austria
82 D - 28 Windspiel

Chapter 8: 85 **Schneider and Grunau**
85 ESG 31
87 Grunau Baby
93 Moazagotl

Chapter 9: 97 **Schempp Hirth**
97 Göppingen 1 Wolf
99 Göppingen 3 Minimoa
103 Göppingen 4 Gövier

Chapter 10: 104 **Hans Jacobs and the factory sailplanes**
104 Jacobs' Hols der Teufel
106 Luftkurort Poppenhausen
106 Rhönadler
110 Rhönbussard
112 Rhönsperber
114 Sperber Senior
117 Sperber Junior
119 Kranich
120 Habicht
123 Reiher
126 Weihe
128 Meise/Olympia

Chapter 11: 132 **Steel tubes and fabric**
132 Münich Mü 10 Milan
134 Mü 13
136 Mü 17
136 Helios

Chapter 12: 140 **More experiments**
140 FVA - 10, Rheinland
143 The Hortens
147 D - 30 Cirrus

Chapter 13: 150 **Australia**
150 Golden Eagle

Chapter 14: 152 **Austria**
152 Austria 2 & 3
154 Musger MG - 9
156 The Hütters

Chpater 15: 160 **Britain**
160 Airspeed Tern
162 The Scuds
162 Carden Baynes Auxiliary, Scud 3
165 The Wrens
168 Slingsby T - 4 Falcon III
168 Hjordis
171 Slingsby T - 6 Kirby Kite
173 Slingsby T - 7 Kadet
176 Slingsby T - 8 Tutor
176 King Kite
176 Slingsby T - 12 Kirby Gull
178 Slingsby T - 13 Petrel
182 Cambridge
182 Scott Viking

Chapter 16: 184 **Czechoslovakia**
184 Tulak 37
186 VSB 35

Chapter 17: 187 **France**
187 Avia 41P
191 Avia 40P
191 S.O.P. 1

Chapter 18: 192 **Hungary**
192 Karakan
194 Nemere
196 M - 22

Chapter 19: 198 **Italy**
198 AL - 3
198 CVV - 4 Pellicano
202 CVV - 6 Canguro

Chapter 20: 203 **Japan**
203 Maeda 703

Chapter 21: 206 **Poland**
206 Salamandra
206 Komar
209 SG - 21 Lwow and SG - 38
209 Czerwinski CW - 5
213 Orlik
213 PWS 101
215 PWS 102

Chapter 22: 218 **Switzerland**
218 Spalinger 15
218 Spalinger 18
218 Spyr 3
221 Spyr 4
224 Moswey

Chapter 23: 226 **USA**
226 Franklin PS - 2
227 Bowlus Albatross
229 Baby Albatross
231 Super Albatross
233 Laister Yankee Doodle
233 LK - 10A (TG - 4)
236 Ross - Stephens RS - 1 Zanonia
237 Schweizer SGU 1 - 6 Boom Tail
239 Schweizer SGU 1 - 7
244 Schweizer SGS 2 - 8 (TG - 2)
244 Schweizer SGS 2 - 12 (TG - 3)
244 Pratt Read G - 1 (LNE - 1 or TG - 32)

Chapter 24: 246 **USSR**
246 Antonov PS - 2
246 Groshev GN - 7
246 Stakhanovetz
246 Rot Front 7

Appendices: 251 About the drawings
251 Colours and markings
252 Acknowledgements
252 About the author
253 Bibliography
254 Index

PREFACE

My first experience of sailplanes was on 15th July 1939 when, as a child of nine years, I visited the British National Gliding Competitions, held at Camphill in Derbyshire. The indulgent father of my friend Brian possessed a small car. He took us boys out for the day to this bare, exposed stretch of upland some 24 kilometres south west of Sheffield where we lived. I had always been fascinated by the idea of flying, as many were. I had seen occasional biplanes passing over our suburb and all the kids in the school yard had once watched a sky writer advertising washing powder.

Gliding was a mystery to all of us. I thought it must be something like sledging which, when there was snow, we did in the streets near home. We could pay a halfpenny, or sometimes a full penny, in the sweet shop for little aeroplanes made of card. These flew well when catapulted into the air with the rubber band (supplied), but they always came down quickly. Today, it seemed, we were to see big gliders, carrying grown men, being thrown off the top of a hill with big rubber bands.

Within minutes of arriving at the flying field, I was enraptured. There began an obsession which has continued for the rest of my life. Not catapults and mere toboggan rides down to the valley floor, but steep, swift ascents like kites pulled up on wires, wings spread against the sky, then long, floating, graceful flight, flute like sounds, smooth turns and gentle landings.

Long afterward I learned that this summer day had been poor for soaring. Only three pilots were able to scratch away from the site in weak thermals. The best distance for the day was a mere 20 km. I didn't see any soaring, or if I did, failed to understand. All I observed were winch launches and circuits hardly longer, though much more beautiful, than those of my halfpenny toys.

Brian and his dad were soon bored and wandered away from the action. They did not see, as I did, one of those beautiful, bird like aircraft with arched translucent wings and gleaming, varnished skin, flying away from the winch with the cable still hanging on. It stopped with a jerk, dived and slammed into the ground to disintegrate in a cloud of dust a few hundred metres from where I stood. I hardly needed to be told the pilot was dead. Later I stared long and sadly at the wreckage, stacked against a wall behind the hangar. That lovely wooden shell was splintered and crushed, bits of fabric still gleaming but torn and flapping wretchedly in the breeze.

How could such a thing have happened to such a wonderful craft? Gliding, so lovely to see, was evidently not without dangers. Such beauty and grace were not achieved easily. A few weeks after that visit, war came. All civilian flying in Britain was forbidden for six years.

I read everything I could find about gliding and soaring. There was little within the comprehension of a child, but I learned and began to collect pictures, drawings, articles, books. One of the most inspiring books about gliding I ever discovered was Soaring Flight by Terence Horsley, published when I was fourteen. I read it avidly and met the author soon afterwards. I still find his writing admirable. The quotation on the title page here comes from Terence's book. It captures in a few words all the sense of awe I felt when I watched sailplanes performing gentle, almost silent, circuits above my head, and when I stared and even touched them on the ground. I did not imagine I should ever be able to fly in one myself. Men who did that, I thought, must be demigods. My parents were strongly opposed to such ambitions.

I did learn to fly as soon as I could. No demigod, I have continued ever since. I have flown about a hundred sailplane types and my archive of books, articles and photographs has never ceased to grow. There is much more literature available now, as the bibliography shows.

In preparing this book, and my earlier writings, I have had help from innumerable people and organisations. As many as possible are listed in the Appendix. For the present volume special thanks are owed to Marici Phillips for translations from Japanese, Brigitte Keane for help with German texts, Vincenzo Pedrielli for advice, photographs and drawings from Italy, Raul Blacksten, archivist for the Vintage Sailplane Association of the USA, Chris Wills, old friend and President of the Vintage Glider Club, Marton Szigeti, who provided several photographs and my publisher, Klaus Fey of EQIP GmbH, whose idea it was to make a new book and who has supported and encouraged me at all stages.

The book is about sailplanes, much less about designers, pilots and advanced techniques. This is no doubt a fault, but it was the aircraft themselves that fascinated me at the beginning. For those whose interest is chiefly in the people involved, or the influence gliding has had on other aspects of aviation and history, or competition strategies in modern soaring, the bibliography lists many references to be followed up.

Martin Simons
Adelaide, 2001

Introduction

The early history of flight has been written many times by other authors and will not be repeated here. A question still requiring an answer is, why did gliding not begin sooner than it did? Controllable kites for sporting combat were flown in ancient China where there are legends of men being carried aloft by them. There were sailing ships and windmills all over the world. No one could doubt the power of the moving air to raise roof shingles, drive boats, pump water and grind corn. Superstition and fear of the gods did not prevent people trying to fly. They usually injured or killed themselves by jumping off towers or cliffs. All the necessary materials and techniques needed to build simple gliders were available, yet not even the genius of Leonardo da Vinci produced anything remotely airworthy.

The first successful gliders were designed and built by the Yorkshire baronet, George Cayley in 1804. He flew 'free flight' models based on a simple kite and built one big enough to carry a boy, probably a household servant, for a few metres. After a long interval, Sir George's man - carrying glider flew in 1849 - 53. The coachman who had been persuaded to act as pilot, survived the flight but resigned at once. Despite Cayley's publications, no one showed any interest. A modern replica of the glider has been flown and proves that Cayley understood the essentials.

Otto Lilienthal began to fly hang gliders in 1891. It was his successes that led directly to the inspired, but business-like, work of the Wright Brothers. They made many gliding flights to develop methods of controlling their aircraft before the extremely brief 12 second powered flight in 1903. It was not until 1905 that they could measure their aeroplane flights in minutes. Not till 1908 did they fly for an hour and were confident enough to demonstrate their success fully in public.

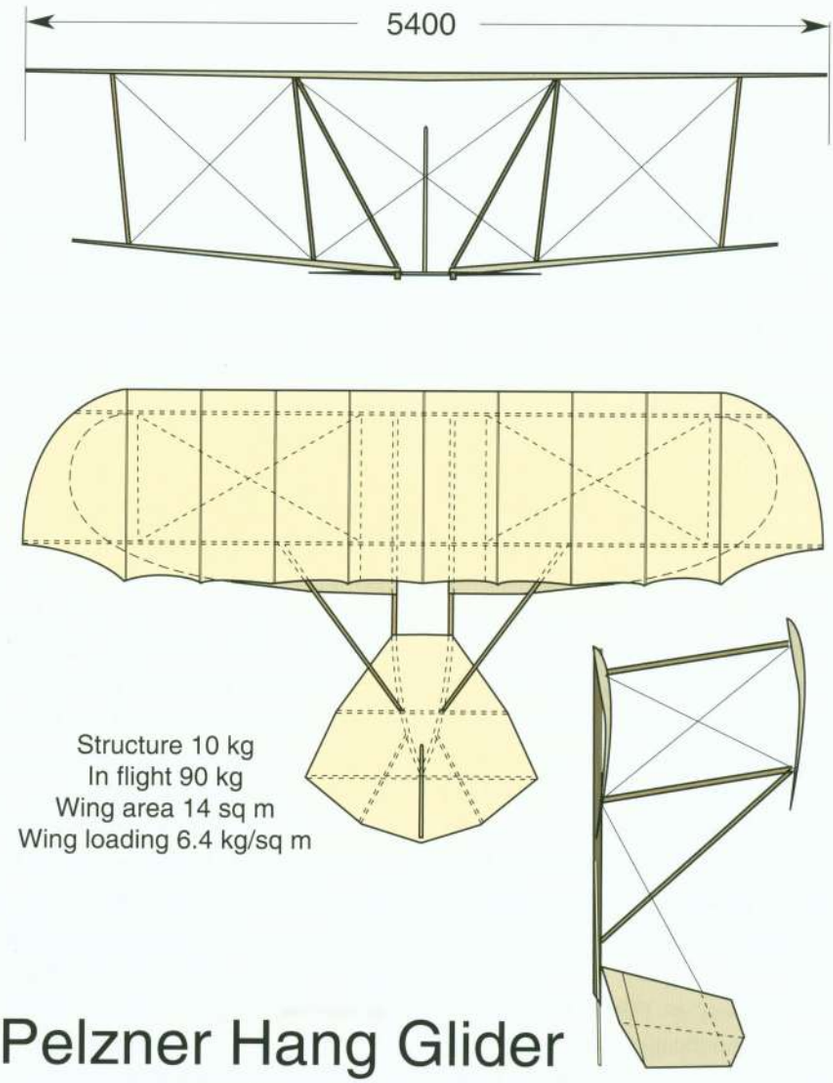
Early pioneers thought of gliding as a mere preliminary to powered flight, but Lilienthal himself had noticed that sometimes he would gain a little height from the wind blowing up a slope. In 1909 E.C. Gordon England, flying a tailless glider built by José Weiss, made a brief soaring flight at Amberley Mount. More significantly, Orville Wright at Kitty Hawk in 1911 soared over the steep dunes for more than nine minutes and afterwards wrote that there was no reason why a duration of several hours could not be achieved. When, at the age of 68, he was asked about the purpose of these experiments he remarked that the brothers had always known it was more fun to fly gliders than powered aeroplanes.

In 1909 a group of schoolboys from Darmstadt formed a club, the Flugsport Vereinigung Darmstadt, and began a systematic and well organised series of trials. Needing more space than they could find near home, they chose in 1911 to continue their gliding on the Wasserkuppe in the Rhön district of central Germany, near Gersfeld. The pastures on and around the summit were made available to them by the local cattle breeders. The land was (and still is) swampy in some places, for here were the springs of the Fulda River, but slopes free from obstructions could be found facing any wind direction. The boys spent the summers of 1911 and 1912 camping there. Their best flight was about 800 metres distance. Their club then was absorbed into a Darmstadt powered flying group and dissolved. World War came soon afterwards. Half the original members of the FSV were killed.

By their choice of the Wasserkuppe, the Darmstadt club had a profound and unanticipated influence on the future development of soaring. Reports of their flights had been published in the magazine Flugsport. After the armistice, Germany plunged into the depths of economic and political crisis which threatened to destroy the nation entirely. The Versailles treaty, finalised in 1919, forbade the construction and flying of aeroplanes. The armed forces of the victorious powers occupied the country, ensuring that this ban and many other restrictions, were enforced.

The Darmstadt boys were now remembered. Erich Meyer, a student at the Dresden Technical University, with his friend Wolfgang Klemperer, another Dresden engineering student, discovered that gliders, in the official mind, were not aeroplanes and so were not forbidden. Meyer published a series of articles in Flugsport, showing how such craft could be built easily at minimal cost. It was a way of getting into the air without running foul of the distasteful law. In March 1920 Meyer and Klemperer published an invitation for a gliding competition, to run from the second week of July till the end of August. It would be on the Wasserkuppe where the schoolboys had proved the ground. No one ever seems to have questioned the choice of site. This was probably not the best possible place in Germany, the weather was often bad with low cloud settling on the top, there was no road, no shelter, no facilities except an isolated tavern, little more than a hut for hikers, on the very summit at 950 metres above sea level, the Baude. This opened only in the summer. To search for another location would take too long. The Wasserkuppe it was to be and the Wasserkuppe it was. The Baude was a very necessary refuge but even to find it in the all too common bad weather, was not easy.

The editor of Flugsport was the enthusiastic Oskar Ursinus who threw all his weight and influence behind the young men's proposal and offered to help organise the event. He knew where to look for financial support, Karl Kotzenberg, a wealthy businessman in Frankfurt. A generous cheque was written, a managing committee was formed and Ursinus set to work. When the time came, tents and small huts were erected on the mountain, and from 20th July the first competitors began to arrive.



Pelzner Hang Glider
1920 - 22

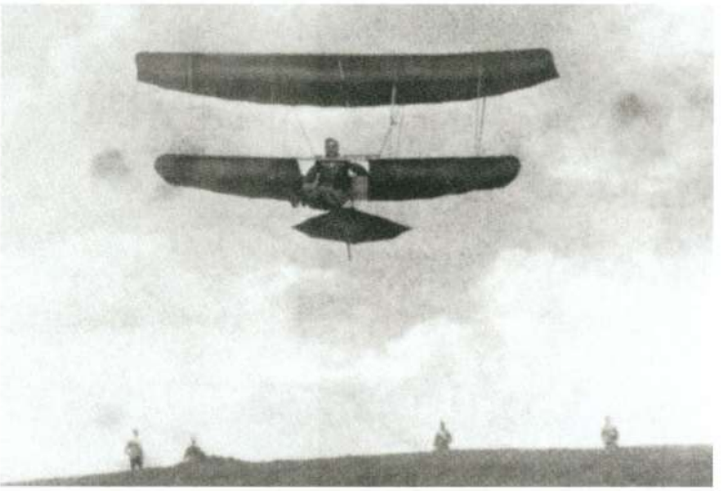
Chapter 1 The discovery of soaring

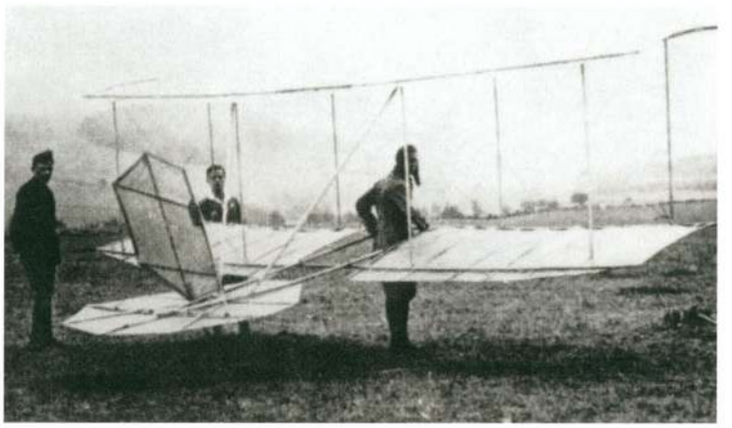
By most standards the first Wasserkuppe meeting was not successful. Aeroplanes had been flying reliably for more than ten years and, partly under the pressures of war, a great deal of theory and good practice in construction and pilotage had been worked out. But some of those arriving at the first gliding contest lacked understanding. They produced strange and even dangerous contraptions which either would not fly at all or, if they did get into the air, collapsed almost at once through structural failure or mishandling, or both.

There was, and perhaps still is, a type of ambitious person so determined to demonstrate the validity of some half mystical belief that they are prepared to stake everything, including life itself, on their convictions. Rather than proceeding by careful and methodical trials and learning from other people's experience, they try to fly instantly like birds without the many millions of years of evolution which brought birds to their present condition. Not much better than the ancient tower jumpers, they failed. This kind of thing continued to some extent for years.

It was recognised that for a glider to make long flights it would be essential somehow to extract energy from the air. No less a person than Gustav Lilienthal, brother and helper of the great Otto, devised a 'rams-horn vortex' theory which, he claimed, would keep a glider aloft by trapping a rotating mass of air below the wing, to drive the aircraft forward. This amounted to a belief in perpetual motion. Quite a lot of hopeful constructors, even skilled craftsmen, lacked the education to see through these claims, and were misled. Some wasted years and small fortunes. Even when regular scheduled airliners were operating outside his shed on the airport in Berlin, Gustav was still trying to build a weird and impractical flying machine.

Only about ten gliders actually made flights at the Wasserkuppe in 1920. Most of these took off only once, usually landing with serious damage. One aspirant who had expended weeks of work, in despair at the end of the meeting, smashed his creation to bits with a hammer and then sat down weeping.



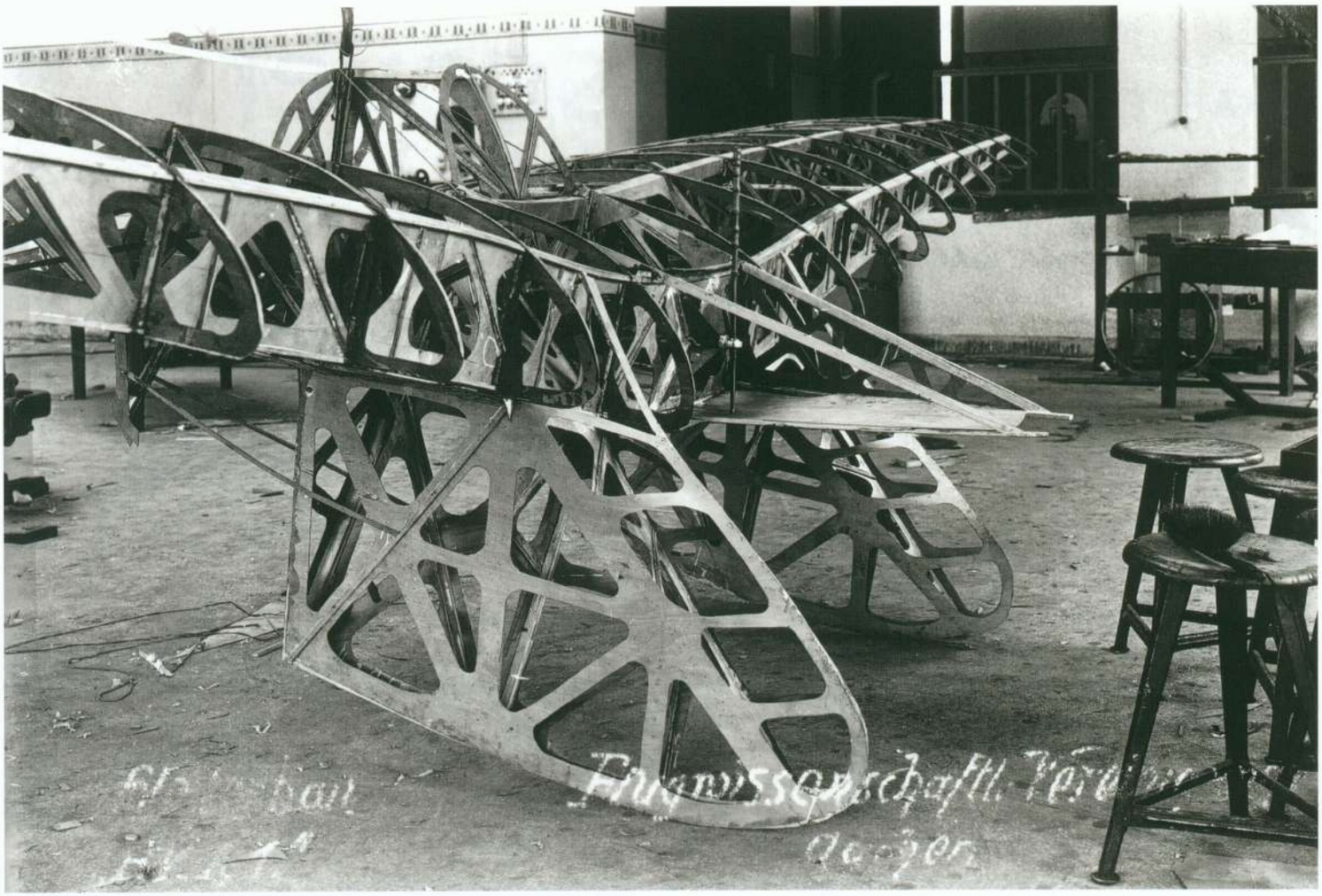


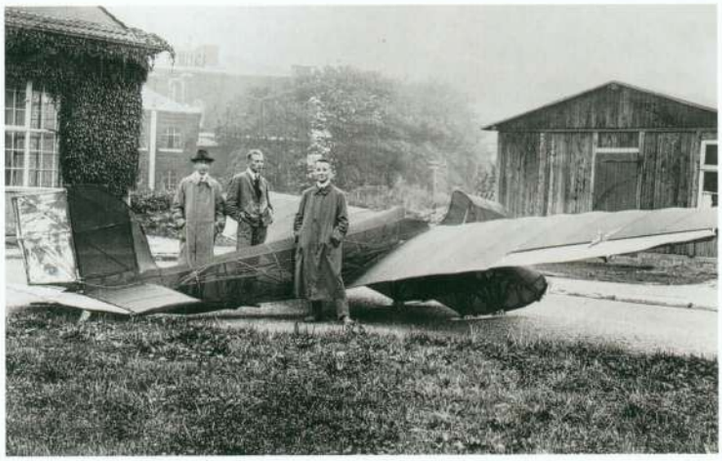
Pelzner with his hang glider

More distressing than the numerous failures to get off the ground at all, one of the more promising aircraft, the biplane of Eugen von Loessl who did achieve one good, controlled flight, lost its elevator on the next attempt after covering about 800 metres. It crashed and Von Loessl died.

Pelzner

For most of that first Rhön meeting, it seemed that the only way forward was through hang gliding. Willy Pelzner built himself a very light biplane hang glider of 5.4 metres span, weighing only 10 or 15 kilogrammes but well braced, the wings and tail unit covered with





Above: The FVA - 1 Schwatze Düvel under construction in the workshop of the Aachen Technical University. The deep wing profile at the root allowed the strong but very light spars to be fully enclosed without external struts or bracing wires.

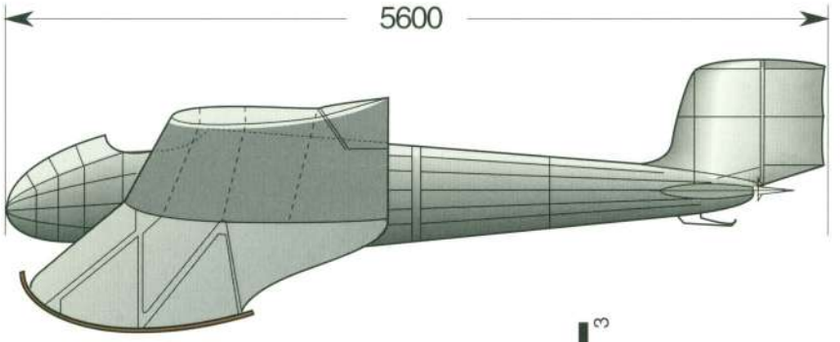
Below: Completed, the Schwatze Düvel was prepared for the railway journey to Gersfeld. On the left is Wolfgang Klemperer, the designer, on the right Peter Terkatz who had the job of riding secretly with the glider in the railway truck, hidden under tarpaulins.

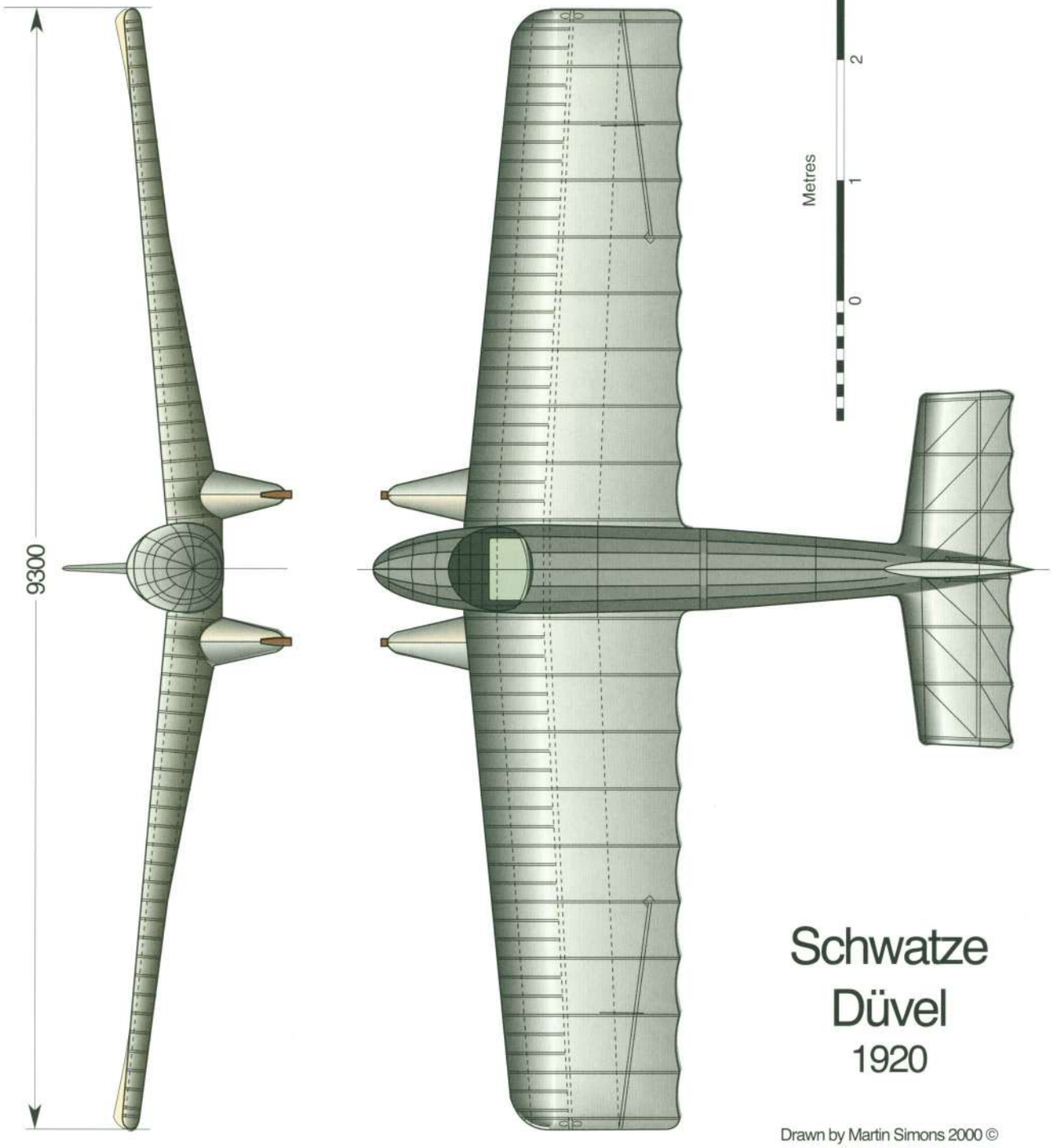
oiled paper. Almost tirelessly, he repeatedly carried his glider to the top of the hill facing the wind, ran forward, took off, controlled the flight by swinging the weight of his body and legs this way or that as needed, and glided to land somewhere down the slope. Pelzner's best flight covered 452 metres distance and lasted 52 seconds. Altogether he achieved 16 recorded flights for a total of 2728 metres, an average of 170 m. This, it seemed, was the best anyone could do.

Schwatze Düvel

It had been a very depressing month. The situation was saved at the last moment. Bad weather ruined the last few days of August so the meeting was extended for another week. Belatedly, from the Technical University of Aachen, came the FVA - 1 Schwarzer Teufel or in the dialect form Schwatze Düvel, the Black Devil. It had been built in a great hurry by members of the Flugwissenschaftlichen Vereinigung Aachen , a student club, one of the academic flying groups or Akafliegs which were to play, and still play, a crucial role in the development of soaring. Wolfgang Klemperer, who at the beginning with Meyer had formulated the idea of the gliding contest, was now a lecturer at Aachen Tech under the outstanding Professor Von Kar-

Structure 62 kg
In flight 136 kg
Wing area 15 sq m
Wing loading 9.07 kg/sq m
Aspect ratio 6.02





Schwatze Düvel
1920

Drawn by Martin Simons 2000 ©

Above: Several examples of the FVA - 2 Blaue Maus were built to order by the FVA. This one was flown by its owner, Mr J. Jeyes, at the 1922 Itford Hill meeting in England, but after take off he drifted into the hill slope, touched a wing tip, cartwheeled and reduced the glider to matchwood. Another of the type was used by Klemperer in experiments to launch gliders from a balloon.

Left: One of very few photographs of the Schwatze Düvel in flight, immediately after launching. The rubber bungee method of launching was invented by Wolfgang Klemperer.

Below: The Blaue Maus after landing in the valley near Gersfeld in 1921. Klemperer stands at the nose.

man. Klemperer designed the FVA 1, a simple monoplane with cantilever wings and orthodox controls, elevator, rudder and ailerons, lightly built but stressed properly and braced internally to withstand high air and landing loads. It was covered in a light, black muslin fabric donated by the girl friend of a student, whose father owned a textile shop. Some cardboard was used to stiffen the covering along the wing leading edges and fuselage nose, the group having insufficient money for aircraft quality plywood. The name Schwatze Düvel was a natural choice, for in ancient myth Aachen had once been plagued by a monster of this name.

The Weltensegler prepares for flight. Disaster followed.

When the weather cleared on 3rd September Klemperer made three successful glides. For the first time a rubber bungee was used for the launches. The third flight duration was 2 minutes, 22 seconds, ending near a village in the valley, 1830 metres from the start. Pelzner's best effort was far exceeded.

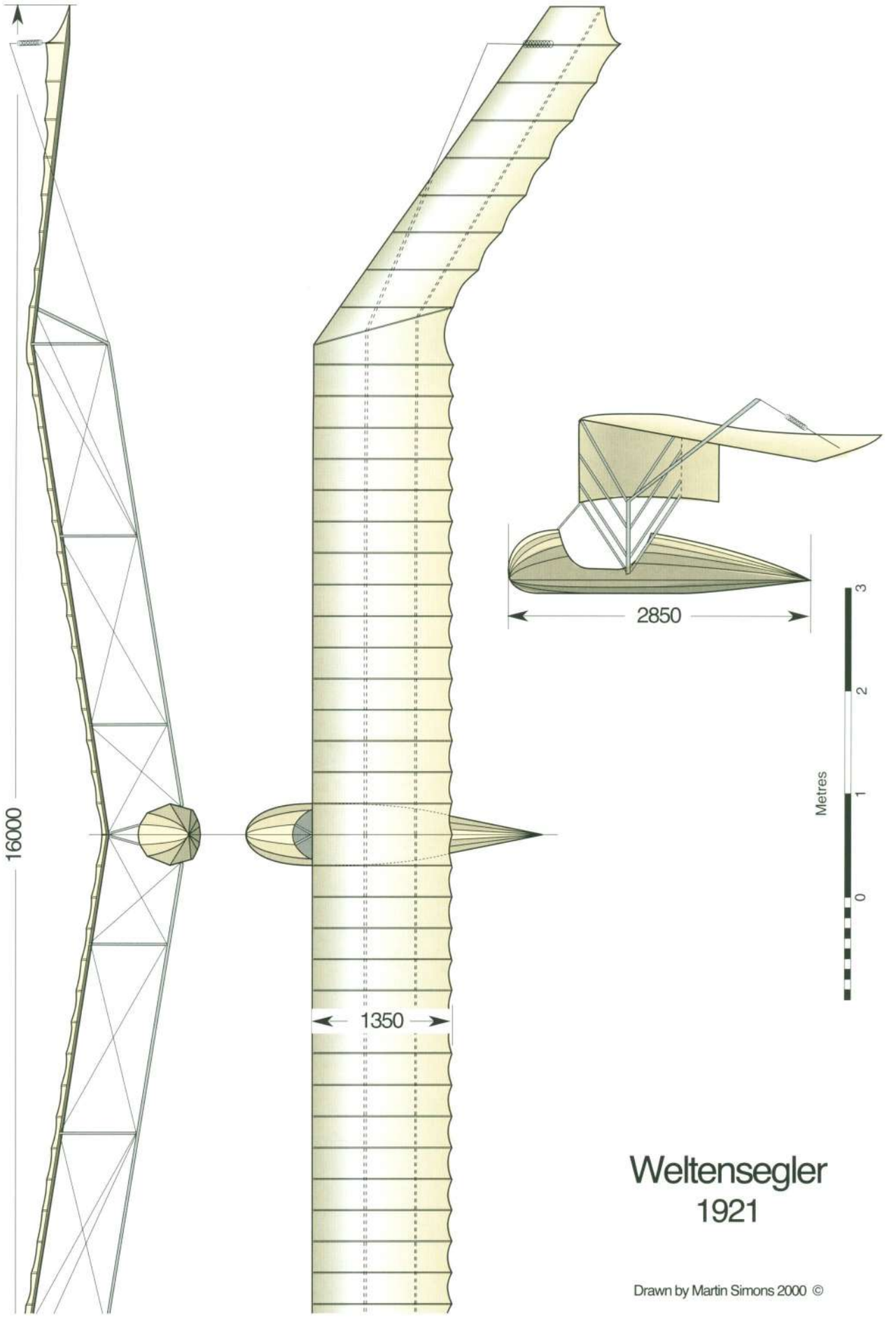
Bad weather returned but on September 7th Klemperer, who knew of Orville Wright's dune soaring of 1911, did succeed in gaining about 30 metres height after launching into a wind of 30 knots, hovering for a minute or so before gliding down to land. Two more flights were made by other FVA pilots, ending in a spectacular stall and crash. This effectively ended the first Rhön competition. There was no question that the FVA - 1 had won but Pelzner's hang gliding gained him second prize.

Despite the poor results, the second Rhön meeting began on August 10th 1921, Willy Pelzner and a new hang glider making the first flight. Some forty-five entries had been received but only a couple of dozen gliders arrived. Several of these were quite unairworthy but there were six hang gliders and five apparently more promising aircraft. Klemperer and the Aachen group came with the Schwatze Düvel repaired and a new glider, the Blaue Maus (Blue Mouse).

Weltensegler

Sadly, within a few days the competition was again almost brought to an end by another fatal accident. Friedrich Wenk had been experimenting with flying since his teen age and had discovered that a tail-less monoplane would fly if the wings were swept back and the centre of gravity was well forward. The outer panels of the swept wing performed the same balancing and stabilising function as a tailplane, providing they were set or twisted to a negative angle relative to the central mainplane. After some limited successes he found generous financial backing, launched a company called Weltensegler GmbH, and established a workshop on the Wasserkuppe. In the new shed the 16 metre Weltensegler was built. The tailless glider was controlled by a curious and quite unorthodox arrangement of cables and springs. Moving the control column forward would bring both wing tips together to a higher angle of attack. The resulting increase of lift behind the centre of gravity would cause the glider to pitch nose down. To return to level flight the pilot would move the stick back but there was no positive link between the pilot's hand and the wing tips. The springs in the control circuit were expected to provide the necessary corrective warp. Moving the stick to left or right would pull one wing tip down but not the other, to bank and turn, and again the springs, not the pilot's hands, should return the wings to the neutral position. Why Wenk adopted this system is not clear but it may be that, like many others at this time, he hoped to extract energy from gusts of wind, a kind of dynamic soaring. A gust would cause the springs to compress slightly. The wing tips would yield under the extra pressure, pitching the glider nose up. The gust passed, the springs would return automatically to neutral, all before the pilot could react. There would be a kind of flapping motion which would transmit some gust energy to the glider and perhaps enable it to gain height. It remained to be tested in practice.

The glider was ready for trial on 14th August. The company test pilot, Willy Leusch, was experienced in powered aircraft. The glider, with him in the cockpit, was lifted bodily by the crew, carried forward at a gentle trot and thrown off into the breeze coming up the slope. At first all went exceptionally well. The Weltensegler, after a momentary hesitation, flew forward and smoothly climbed to about 80 metres above the launch point. But a turn to the left became a steepening spiral dive and the airspeed increased rapidly. In aerodynamics, loads generated by an airflow increase according to the square law: twice the speed means four times the force. The springs could not provide sufficient corrective power. Within sec-



Weltensegler
1921

onds the wing fluttered and collapsed, the nacelle fell down the slope with the remnants of the flimsy wing trailing like a banner. Leusch was killed. Gloom descended over the camp.

Nonetheless, Leusch had soared. However briefly, a glider had gained altitude in flight after a gentle launch. Recovered from their shock, the witnesses remembered but at the time, not many understood. It was still supposed by some that gust energy and instant changes of the wing's angle of attack to the airflow, were responsible for this, drastically limited, success. The idea of gust soaring was not abandoned; even Klemperer was attracted by it, other leading scientists supported the notion. The proposed solution was, not to rely on dubious springs and automatic controls, but to let the pilot alter the wing angle of attack instantly on feeling a gust, riding it up, then gliding forward anticipating another surge and ready for it.

Probably today it would be recognised that Leusch was carried up simply by slope lift, the air rising up the hill. Perhaps a thermal was passing through as he took off.

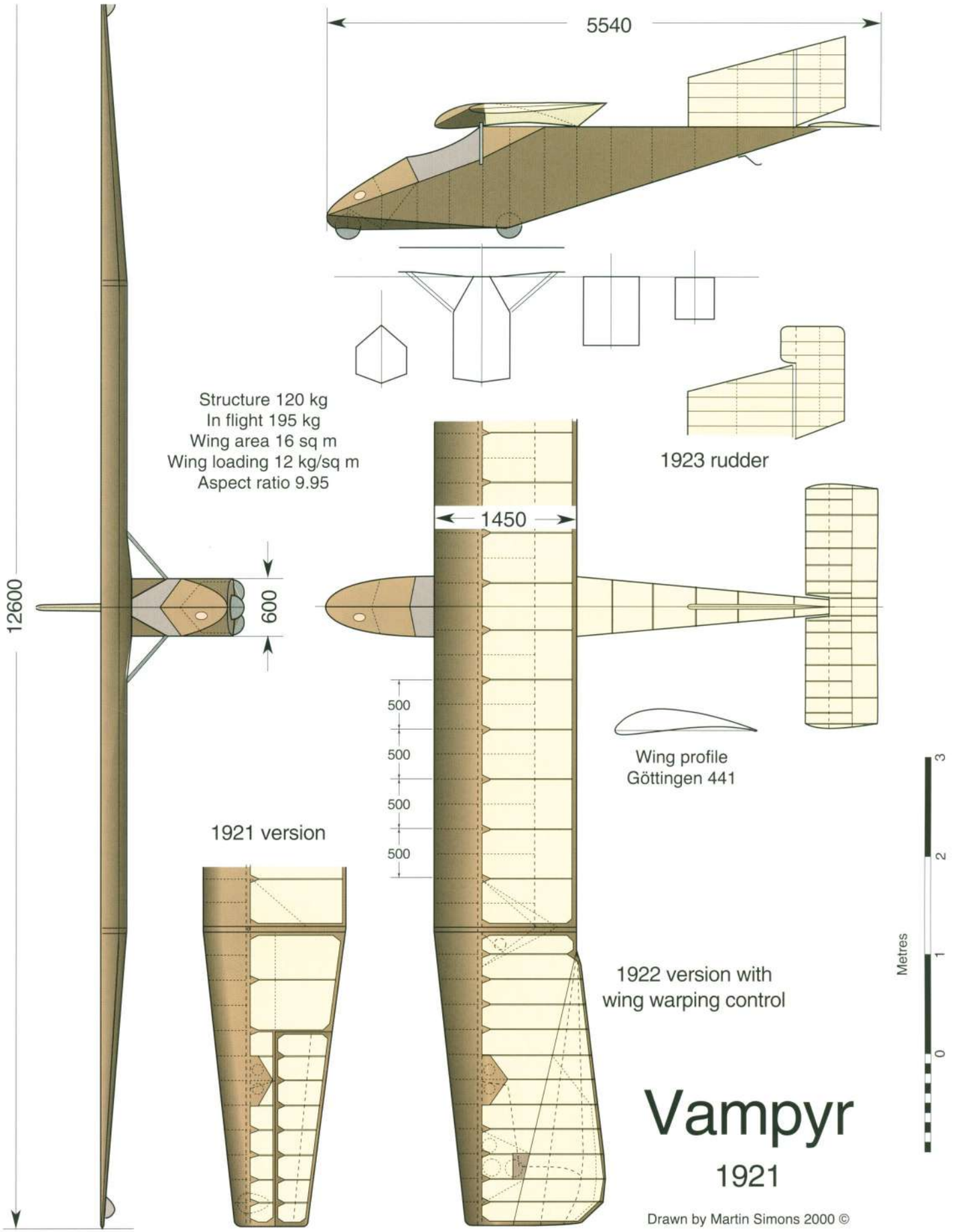
The Vampyr, showing the pneumatic, tricycle undercarriage and the leather cockpit cover which was fastened over the pilot's shoulders, leaving only his head exposed. The pilot here is Hentzen.

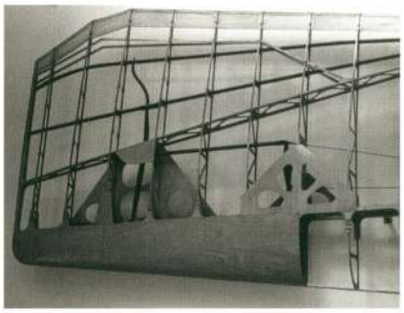
Vampyr

On August 21st the Akaflieg from Hannover arrived with their new glider, the Vampyr. This was revolutionary. Designed by lecturer George Madelung working under Professor Arthur Proell, of Hannover Technical University, the Vampyr was built professionally at a Hannover coachworks. The box-like fuselage, skinned with plywood and varnished, was not particularly refined, though the cockpit was almost fully enclosed by means of a leather cover, leaving only the pilot's head exposed. The wing, in three pieces, a centre section mounted simply on top of the fuselage with detachable outer panels, was superior to anything seen before at the Wasserkuppe and, indeed, was more advanced in some ways than the wing of any other type of aircraft.

The Vampyr had a stressed skin.

Almost all aircraft in 1921 had wings with multiple spars and cross bracing. The most usual layout for powered aeroplanes at this time, and for another ten years, was the biplane with exposed struts and numerous diagonal wires. These formed a strong truss to resist


5540
12600
600
1450
500
500
500
500
Structure 120 kg
In flight 195 kg
Wing area 16 sq m
Wing loading 12 kg/sq m
Aspect ratio 9.95
1923 rudder
Wing profile
Göttingen 441
1921 version
1922 version with
wing warping control
Metres
0
1
2
3
Vampyr
1921
Drawn by Martin Simons 2000 ©



Left: The Vampyr soaring.

Right: The Vampyr wing, as displayed in the Deutsches Museum, showing the complicated wing warping mechanism adopted for the 1922 Rhön competition. It was in this form that the long soaring flights were made.

both bending and twisting. The high penalty in terms of air resistance was accepted. There was enough engine power available to permit flight, the structures were light so useful loads could be carried although speeds were low. If the engine failed, the glide angle was steep and the rate of descent rapid.

The Vampyr wing had only a single spar. There was a very short strut near the root, to relieve some of the high bending moment and transfer the stress there to the fuselage. All the other loads, especially torsion which would tend to twist the wing, were resisted by a thin plywood skin wrapped completely round the leading edge, glued to the ribs which formed the forward third of the aerofoil section. A tube of D shaped cross section was formed. The wings behind the spar were the lightest possible framework of ribs covered with fabric. (The idea of stressed skin construction was published first by Adolph Rohrbach, a designer for the Zeppelin - Staaken Company, but was not widely adopted until long after sailplanes had demonstrated its benefits.) Aerodynamically the Vampyr also had another great advantage. Because of the stressed skin, the wing could have a high aspect ratio, a large span in relation to its total area. This, as new theories developed in the University of Göttingen showed, had a most important effect in reducing drag at gliding airspeeds.

The Vampyr quickly demonstrated a performance much better than anything earlier. Arthur Martens, the pilot, made several long gliding flights into the valley, though not yet soaring. After several flights, the Vampyr was damaged in a launching mishap. The competition was almost at an end so Martens did not win, but the excellence of the Hannover design was recognised with a special award.

The Hannover and Aachen students stayed on after the others dispersed. Klemperer's Blaue Maus, not blue but covered in ordinary white fabric, was an improvement on the Schwatze Düvel, with the pilot's seat lower in the fuselage and a slightly larger wing, but it represented no substantial advance in design. The Blaue Maus was not a very efficient sailplane but Klemperer was a trained engineer who now had some gliding experience. On 30th August he again made a brief soaring flight over the windward slope, performed a well controlled 360 degree turn in the rising air, then glided down into the valley to land 4.6 kilometres away, the duration being over 13 minutes. It was a record surpassing Orville Wright's flight of 1911, though Klemperer had been gliding down most of the time. The principles of hill soaring were understood now by some, but full public demonstrations were still lacking.

The Vampyr, when repaired, began to show its potential and Martens achieved a 7.5 kilometre flight early in September, still without soaring.

Harth and Messerschmitt

Almost unknown to the Wasserkuppe people, Friedrich Harth with a young boy assistant, Willi Messerschmitt, had been working for years on gliders. Harth was one of those who was convinced that soaring required the use of gusts. The Harth gliders were controlled in pitch by changing the angle of incidence of the mainplanes, the tailplane being fixed. The pilot sat within a light framework below the wing with two control sticks, one to change the angle of wing

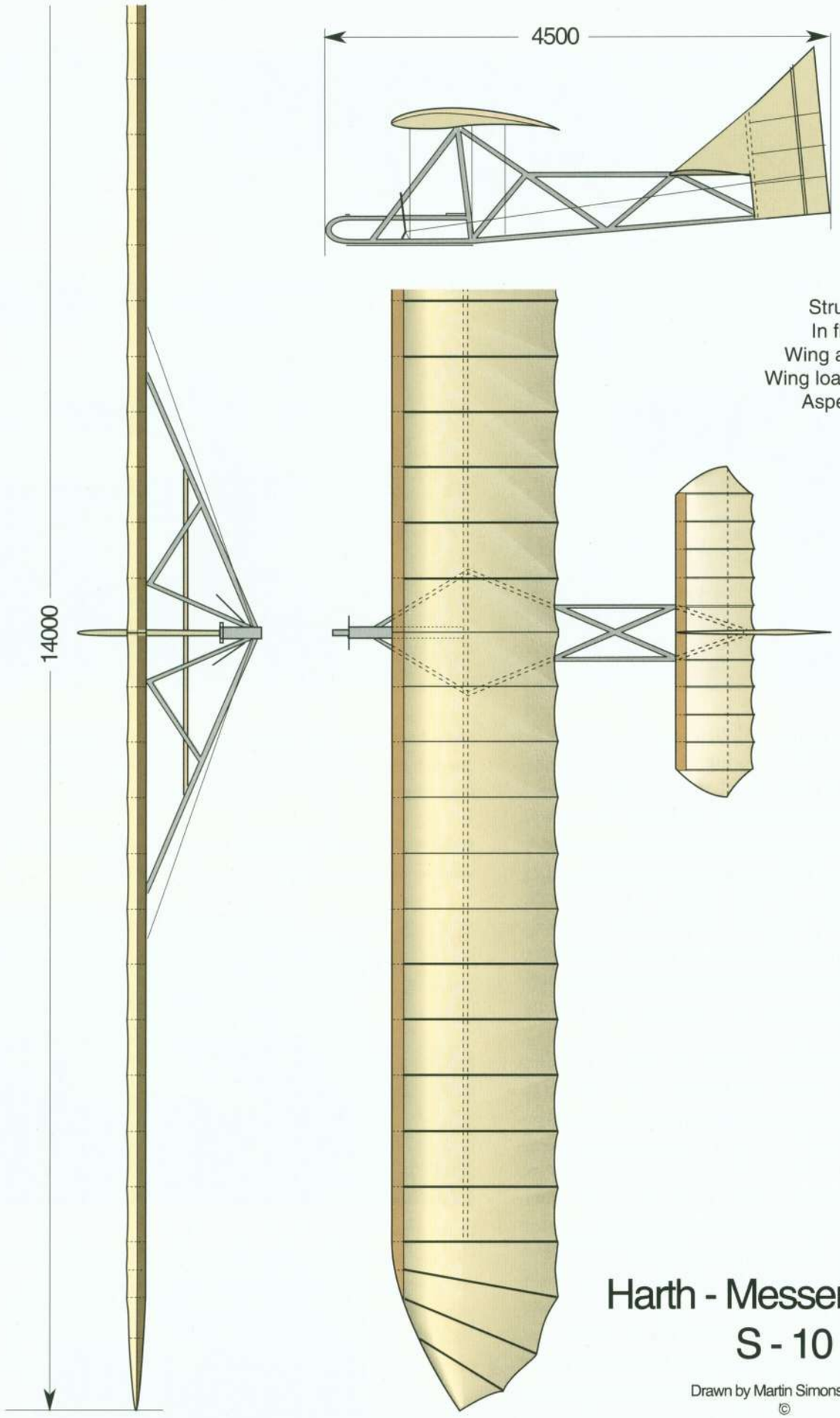
Left and right: The Harth Messerschmitt S - 10 in flight. Control in pitch was achieved by pivoting the mainplane on its transverse axis, a method of control which Messerschmitt used on several later sailplanes, and which was tried also by the Darmstadt students for their Geheimrat.

Below: Wolf Hirth at the controls of the S - 10.

incidence and the other to warp the tips for lateral control. From a standing start in a gusty wind the pilot, on feeling a sudden rush of air, pulled the wing up to a high angle of attack. The glider ought to take off. Once off the ground the machine would start to descend again but, if another gust came in time, the pilot would feel it, pull the stick back and ride up further. It sometimes seemed to work. It did prove possible to take off this way.

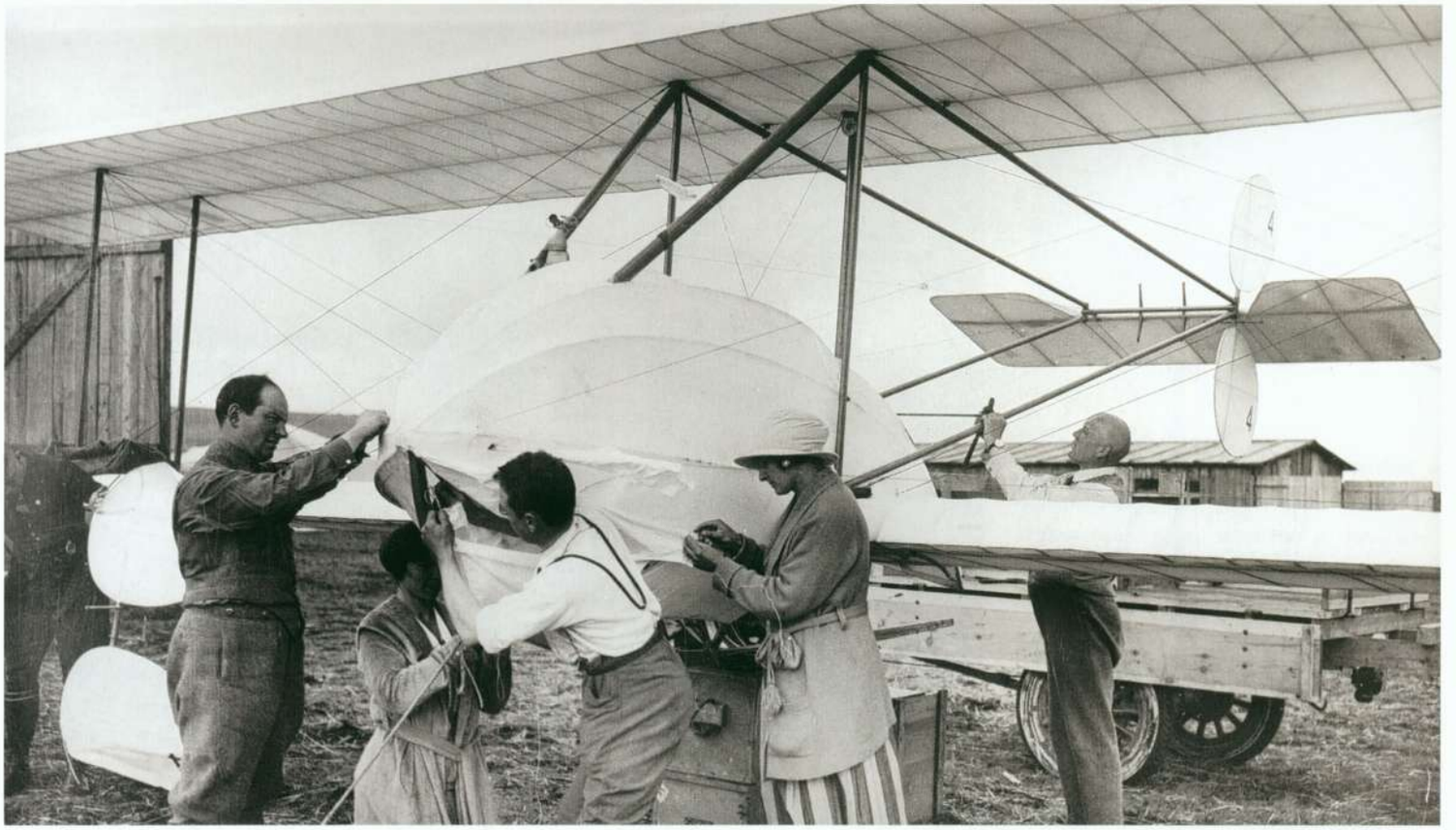
Harth and Messerschmitt did not join the early Rhön meetings but took their glider to Heidelstein, where there was a relatively gentle slope on the flanks of the main valley. They were actually within sight from the Wasserkuppe, but preferred to keep their efforts secret and discouraged investigation. On September 13th, in their glider called S - 8, Harth was able to take off in a gust, gained height and flew under full control back and forth, rising to about 150 metres. This was undoubtedly a soaring flight. Messerschmitt was the only witness and took a hasty photograph but Harth suddenly lost control of the glider and crashed, with serious injuries. The cause was probably a jammed control pulley. The duration was over 21 minutes, a record, but whether gust energy was the explanation seems doubtful. A gust is normally followed by a lull. Energy gained is almost immediately lost and any short term advantage is discounted by the subsequent loss of airspeed and height. Possibly Harth was, after the take off, assisted by some slope lift and thermal. Whatever the explanation, the flight drew little attention although the idea of controlling the sailplane by altering the wing angle of incidence rather than using an elevator, was not abandoned. Messerschmitt himself used this system on several further gliders, before he moved to powered flying and more orthodox controls. Harth recovered but was never the same again.

In 1922 activities on the Wasserkuppe began early in the year with several new designs built and flown before the third Rhön competition officially began. Alexander Lippisch and Gottlob Espenlaub had even spent the winter on the mountain, sleeping at first in a crude 'A frame' shack and, when this blew away in a snowstorm, breaking into the Weltensegler sheds and making do there on the floor. Lippisch was a well qualified aerodynamicist who had been employed by Dornier during 1918 but because of the restrictions on German aviation, was now unemployed and living in penury on the Wasserkuppe. He carried out experiments with large, tailless models. Espenlaub, a skilled woodworker, having taken the theories about aspect ratio to heart, began to construct a sailplane



Harth - Messerschmitt
S - 10

Drawn by Martin Simons 2000



with a 17 metre wing span, raiding the Weltensegler workshop for materials. Messerschmitt came in the spring, erected a shed and began work on the S - 9 and, when this failed, the S - 10. Small barrack huts were built. When the contest proper did begin, the Vampyr, with the outer wing reconstructed to use wing warping instead of ailerons, arrived from Hannover. Other new gliders followed Hannover's lead towards stressed skins and high aspect ratio wings, the Edith and Geheimrat from Darmstadt, Espenlaub's E - 3, a new tailless and more practical design from Wenk, a 'canard' or tail first type from Klemperer, intended for gust soaring, the new Messersmitt and more. Many of these gliders flew successfully, some did not.

The great events of the meeting were the extended slope soaring flights by the Vampyr. On August 18th Martens was launched by bungee and at once soared up confidently over the western slopes as the crowd on the summit cheered. He had no instruments and not even a watch. The spectators signalled his achieved duration to him by lying on the ground in patterns; eighteen minutes, then thirty. He achieved his immediate goal of forty minutes duration and turned to glide down into the valley. Late in this descent he realised that with a little more careful flying he could extend the glide to achieve a full hour. This he was able to do and landed 7.5 kilometres from the launch point. The next day Martens' colleague, Heinrich Hentzen, soared the Vampyr for two hours with a long glide down to land 9 kilometres away. A few days later Hentzen flew for three hours. All previous duration, distance and height records were eclipsed.

Above: Anthony Fokker (left) with assistants, stitching the fabric covering onto the nacelle of his biplane two seater. Behind Fokker a workman attends to one of the double disc shaped rudders.

Below: Fokker in his biplane prepares for a solo flight and takes off. Note the rudders were later extended by adding extra sections above and below.

The Peyret takes off, dropping the rubber bungee as the glider passes over the heads of the launching crew.

Others were quick to learn. Not only Martens and Hentzen but other student pilots, especially those from the Technical University of Darmstadt, made long soaring flights with the Edith and Geheimrat.

Anthony Fokker's biplane

Anthony Fokker visited the Wasserkuppe first in 1921, with his cine camera. In August 1922 he arrived with a biplane two seater which had been hastily built at his factory. He test flew it, solo. Area was added to the rudders and he then made the first passenger carrying, soaring flight. It lasted thirteen minutes. There were times during the closing days of the 1922 Wasserkuppe meeting when four or five sailplanes were flying simultaneously. These flights, though not always fully understood, stimulated interest around the world.

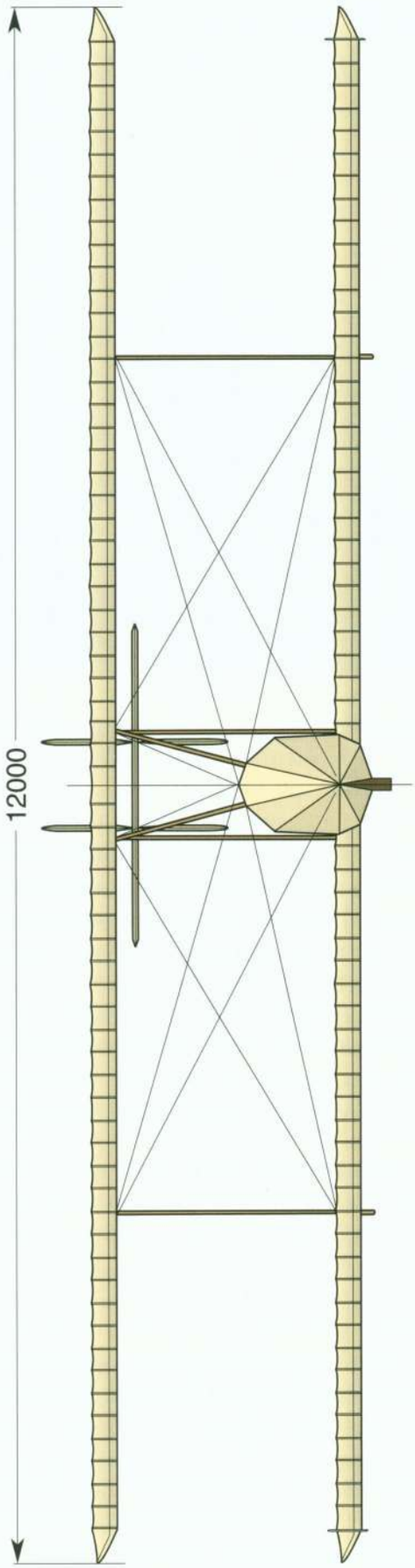
Partly as a publicity stunt by the Daily Mail newspaper, a glider meeting was organised in England on the South Downs north of Newhaven, at Itford Hill and Firle Beacon, during the week of 16th - 21st October 1922. A prize was offered for the longest duration over 30 minutes. Fokker took his biplane and raised the soaring record to 37 minutes. He then allowed his aircraft to be flown by an Englishman, Captain Olley, who set the new figure at 49 minutes.

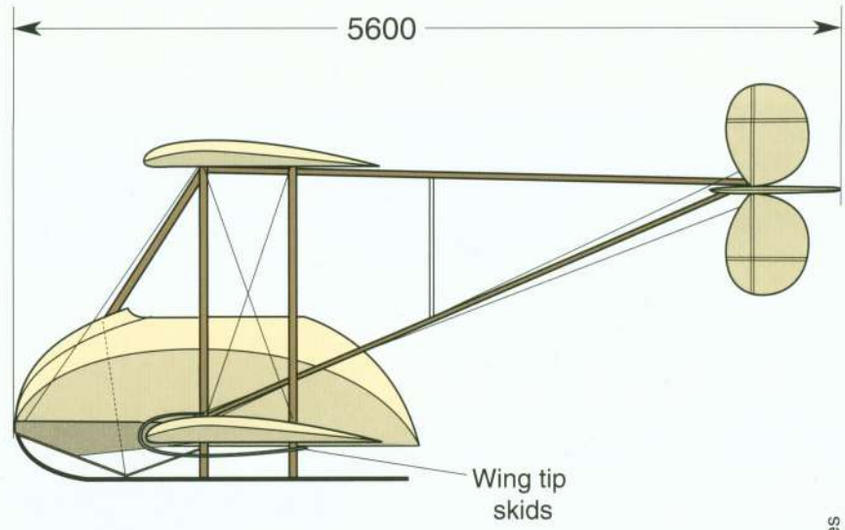
That Fokker was able to fly his biplane both solo and dual, was significant. The dilemma facing all designers of two seat sailplanes is that, lacking any concentrated weight such as an engine, the human beings on board have a great effect on the location of the balance point. If the centre of gravity is too far back, the aircraft becomes dangerously unstable. Having the centre of gravity far forward is less dangerous but can lead to lack of elevator control, especially important when landing or taking off. In Fokker's biplane the two seats were one behind the other in a large fabric covered nacelle. The rear seat was between the twin spars of the lower wing. With both seats occupied the centre of gravity probably moved aft.

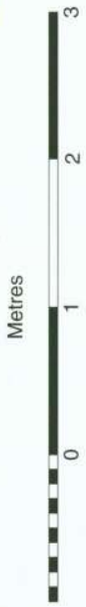
Fokker also built a single seat biplane glider but he does not seem to have flown it often.

Peyret Tandem

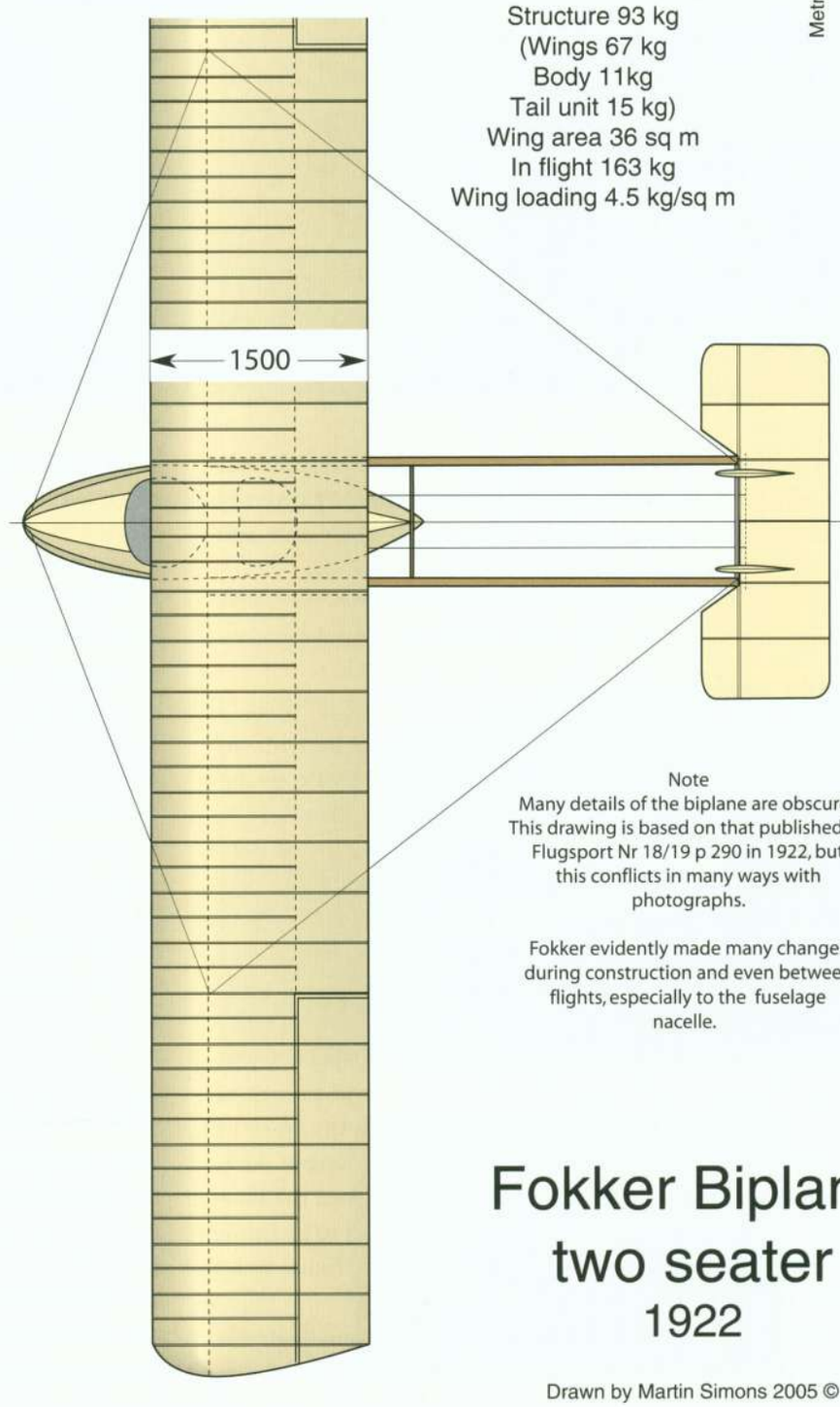
There was a glider meeting in France at Combegrasse which achieved little except that one pilot apparently soared, unintentionally, in a thermal for three full turns. No one recognised this for what it was. On the last day of the Itford meeting in England the French pilot Alexis Maneyrol set a world record of 3 hours 21 minutes. Maneyrol was flying the Peyret Tandem. Peyret, the designer, was enthusiastic about the tandem layout. By dividing the total lift-







Structure 93 kg
(Wings 67 kg
Body 11kg
Tail unit 15 kg)
Wing area 36 sq m
In flight 163 kg
Wing loading 4.5 kg/sq m

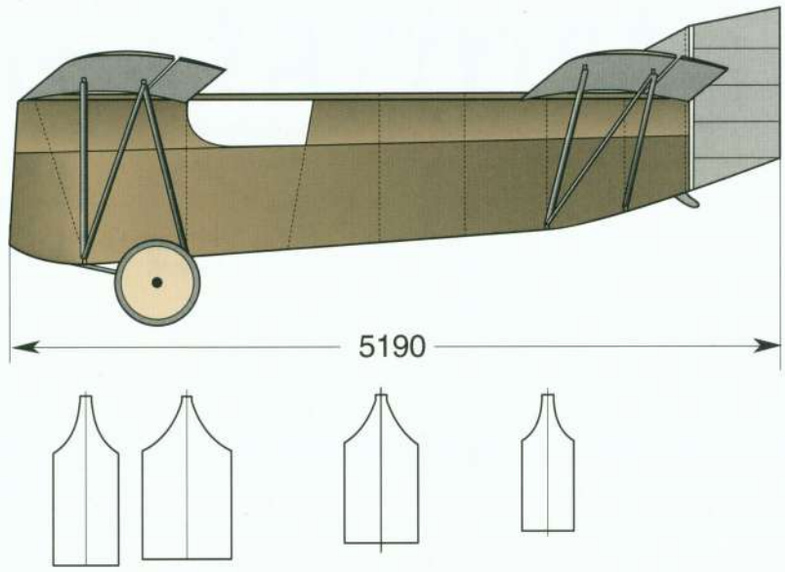


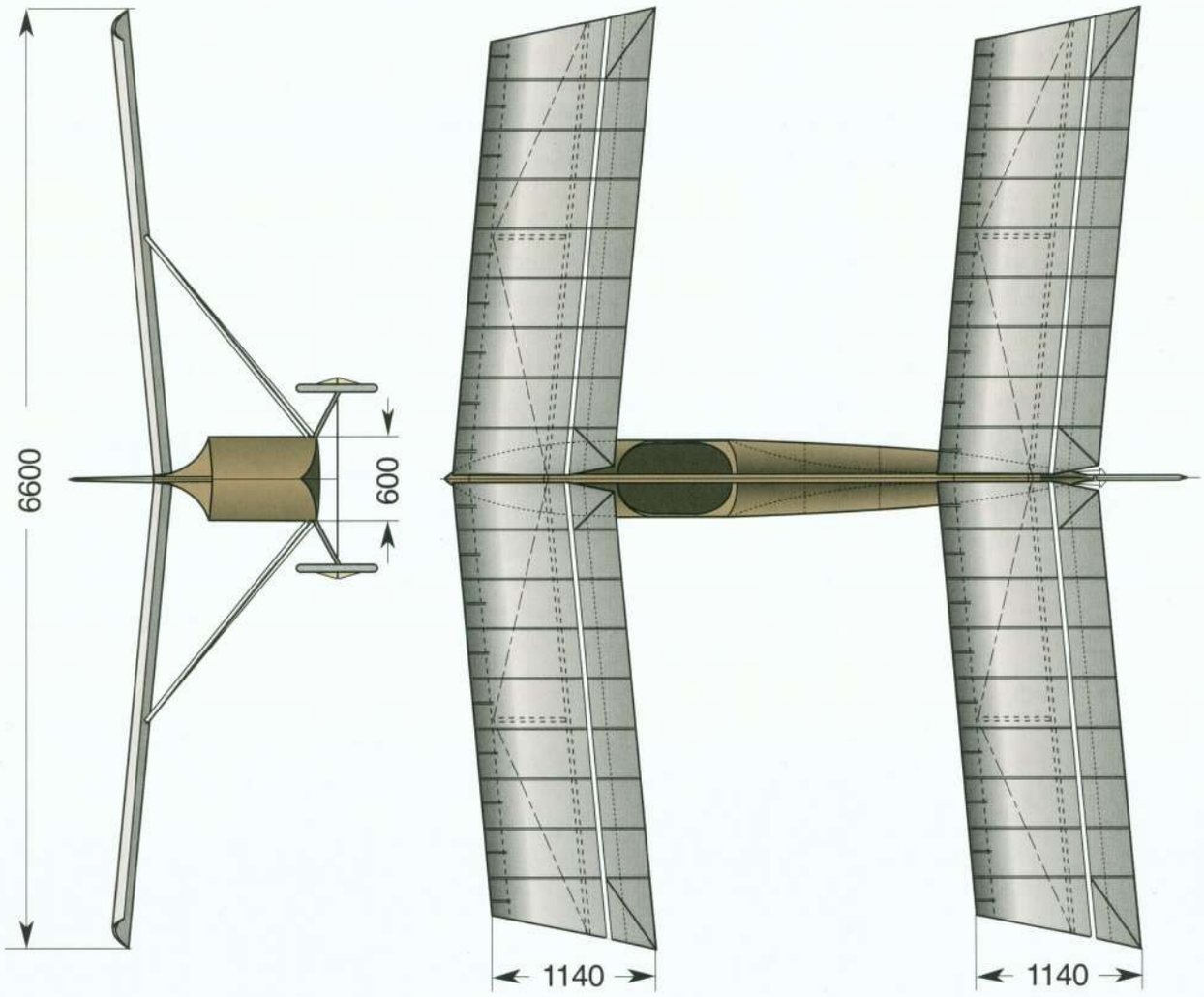
Note
Many details of the biplane are obscure. This drawing is based on that published in Flugsport Nr 18/19 p 290 in 1922, but this conflicts in many ways with photographs.

Fokker evidently made many changes during construction and even between flights, especially to the fuselage nacelle.

Fokker Biplane two seater 1922

Structure 67.5 kg
In flight 138 kg
Wing area 14.2 sq m
Wing loading 9.7 kg/sq m
Aspect ratio 6.22 (each wing)





Peyret Tandem

Drawn by Martin Simons 2005

ing area into two equal, narrow chord wings, one behind the other, the benefits of a high aspect ratio might be achieved without a vast wing span and consequent structural and control problems. However, as with the usual biplane layout, mutual interference between the two planes reduced this advantage. Downwash and turbulence from the foreplane adversely affect the flow over the rear surface. The Peyret design suffered from another important defect. Where the wings joined the fuselage, there were gaps through which air would pass from the underside of the lifting surface to the upper, almost like an extra wing tip. The extra drag and loss of lift caused by this was very great.

The wing structure was quite orthodox, with twin spars, cross braced and strutted, covered with a grey rubberised fabric. With the very large N struts and rather basic fuselage, a clumsy though effective wheeled undercarriage, the Tandem had very limited performance. Nonetheless, it flew well enough in strong slope lift against the other hastily designed and constructed gliders at Itford, which included a Blaue Maus imported from Aachen. Maneyrol won the prize, not because his aircraft was superior but because the other pilots, feeling somewhat complacent, had given up too soon. The Englishman Raynham had soared his glider, called the Brokker because it was cobbled together from an F2 - B Bristol Fighter fuselage and a Fokker D - 8 wing, for two hours earlier in the week. He had thought that was enough.

The Peyret flew again in January the following year, soaring the cliffs at Vauville for over eight hours, only to have this figure topped within the week by Barbot in a Dewoitine glider. A second Peyret tandem was built and flown in North Africa. By 1924 the duration record was set at 8 hours, 42 minutes by the schoolteacher Ferdinand Schulz flying over the huge sand dunes of the Baltic Coast in East Prussia, near Rossitten. Schulz's 'Broomstick' was one of the crudest and cheapest gliders ever to get off the ground. It was not permitted to fly at all at the Wasserkuppe, where a technical committee existed to prevent obviously unsafe craft from taking off. Rossitten, nevertheless, became an important centre for soaring after this.

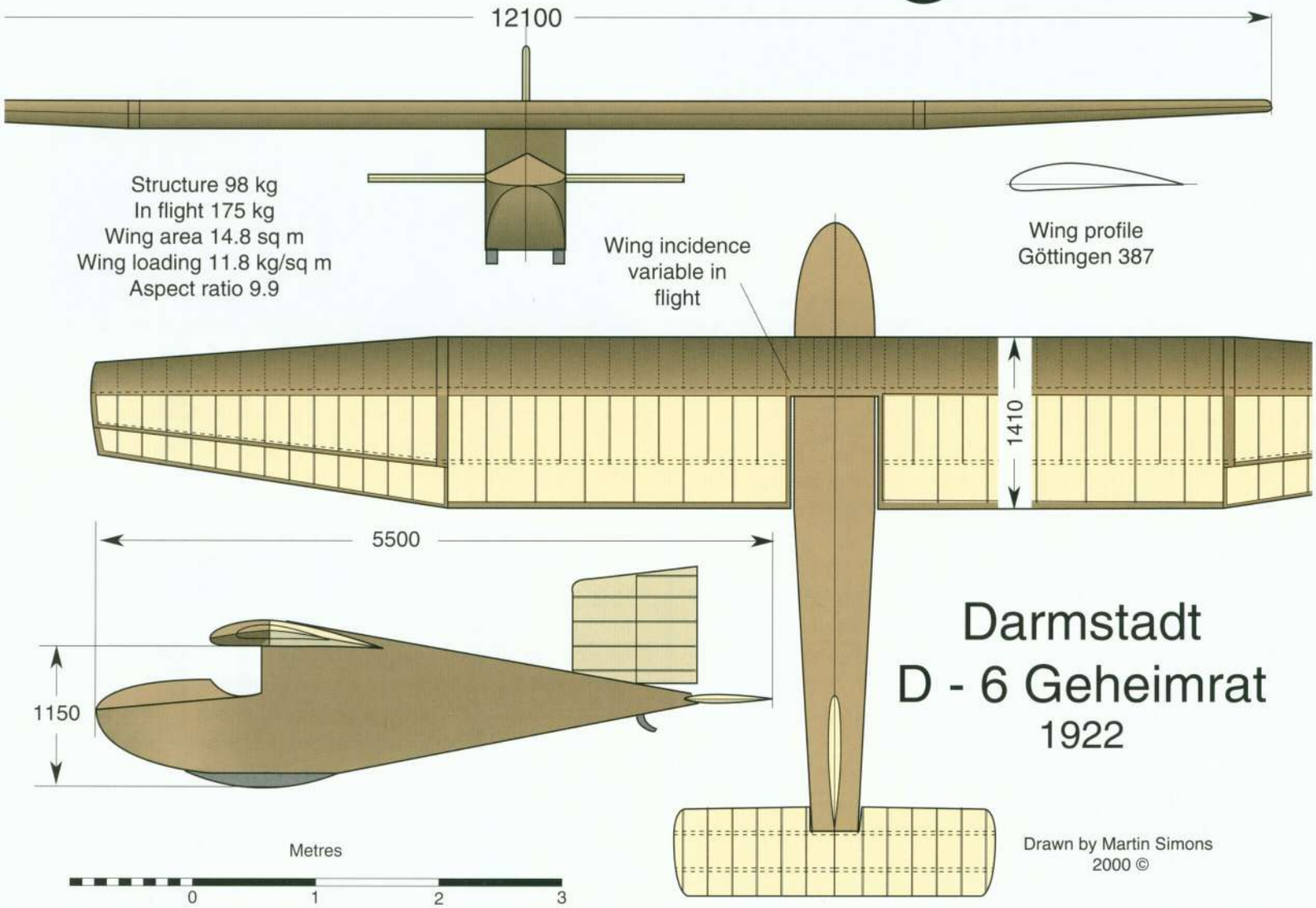
It was now evident that, providing there was a suitable slope and a breeze blowing up it, even an unrefined sailplane, flown with some skill, could remain airborne almost indefinitely. Following the Vampyr, the Strolch and the Moritz were built for Martens by Karl Bremer. They were, in all important respects, copies of the Vampyr but the wing spans were extended for higher aspect ratio and consequent improved performance, with orthodox ailerons on the tapered outer panels. They had considerable success when flown by experienced pilots. Martens won the 1923 Rhön and later, in Italy, broke the distance record in Strolch, but this sailplane, like many others of the time, had dangerous spinning characteristics. It was written off early in the 1925 Rhön when Karl Bedall span in soon after the launch on the Wasserkuppe. He was badly injured. Martens in the Moritz won in 1925 and Schulz set a new duration record of just over 12 hours flying in the Crimea during a famous visit to the USSR that year by a German group.

For many of the German enthusiasts, soaring was no more than a legal way into the air that would enable them to improve their skills, ready for powered flight when the Versailles bans were lifted. This happened in 1924. Light powered aeroplanes were allowed in Germany again and, for many, the need for gliding disappeared. The movement went through a bad period as many of the experienced pilots and engineers moved on.

For others, especially the young, soaring was a new sport, offering adventures and experiences of an entirely new and different kind from powered flying, and less expensive. For students and staff in technical colleges and universities this was also a way of learning, experimenting and, in a practical way, improving the efficiency of aircraft at minimal expense. An aeroplane might be made to fly faster or climb better by using a more powerful engine. For a sailplane, the only way to improve performance was to refine the aerodynamics and structure. This was the way forward.

Dragging the Peyret Tandem to the launching point on Itford Hill in 1922. At this stage, nothing much was expected of it.

CHAPTER 2 The Darmstadt School of Design



The Akademische Fliegergruppe Darmstadt or Akaflieg was founded in January 1921. The students at the Technical University included many who had survived the First World War and were now anxious to complete their interrupted education. They were more experienced, dedicated and serious than some of the younger boys straight from school. Most who chose to study aeronautics were pilots or had been trained to rig, repair and maintain fighting aeroplanes and their engines.

They established a tradition which continues to the present day. The Akaflieg was conducted along democratic lines, decisions were made collectively after open discussion. Membership was free but subject to strict rules. Each applicant was required to work hard at the agreed projects before being accepted. Full membership required great sacrifices of time, money and social life. Akaflieg students often took longer than non-members to complete their formal qualifications. The practical experience in design and construction was more than adequate compensation for a year or two's delay.

It was of great importance that their college supported the group. A design office, workshop, academic and practical assistance were pro-

Above: The Darmstadt Margarete of 1923. Second pilot well back below the wing.
Left: The Margarete flown solo at the Wasserkuppe.

vided. Geheimrat (Councillor) Professor Max Friedrich Gutermuth was the father of Hans Gutermuth, one of the original Darmstadt boys who had first flown gliders at the Wasserkuppe. (This was the only direct connection between the Akaflieg and the FSV.) The group's sailplane of 1922, the D - 6 Geheimrat, was named after the Professor.

D - 7 Margarete

The biplane layout is inherently inefficient, except when the lightest possible weight with large wing area is required. When the Darmstadt students turned their attention to a two seat sailplane in 1923, they chose a monoplane layout. The D - 7 Margarete was named after the Margarete von Loessl whose husband Eugen had been killed at the first Rhön meeting in 1920.

There were very good reasons for adopting a tandem layout for the seats. With one pilot behind the other, the frontal area could be reduced, saving the drag of a wide fuselage. To avoid an excessively long nose, the rear pilot's rudder pedals and feet were arranged on either side of the front seat, so the width of the cockpits was more than in a normal single seater but this small additional drag was acceptable. The rear seat then could be placed immediately on the balance point. This allowed the sailplane to be flown solo, from the front cockpit, without the need for additional trimming ballast. It was easy to arrange for dual controls. The cockpits were open with no windscreen, as usual for the time.

There remained the difficulty of providing the rear pilot with an adequate view. In the Margarete, the wing was mounted above the second cockpit. The main fuselage frame, behind the seat, required a forward extension above to carry the central wing mountings. Large V struts braced the wing so the bending and torsional loads at the centre were relatively light. The rear pilot had a perfectly adequate view to the sides and, by leaning sideways slightly, could look ahead beyond the front pilot's head. In the upward direction there was no view at all. In the early days when very few other gliders were likely to be in the air this did not seem to matter. As skies became more crowded, it became vital to keep looking into the centre of a banked turn. With the wing in the way, this was impossible. The rear pilot could turn to look sideways and backwards but the large blind spot created by the wing was a serious difficulty. The front pilot was required to keep a good lookout but, if inexperienced in the air, might not be very reliable. The problem remained for all subsequent designers of two seat sailplanes.

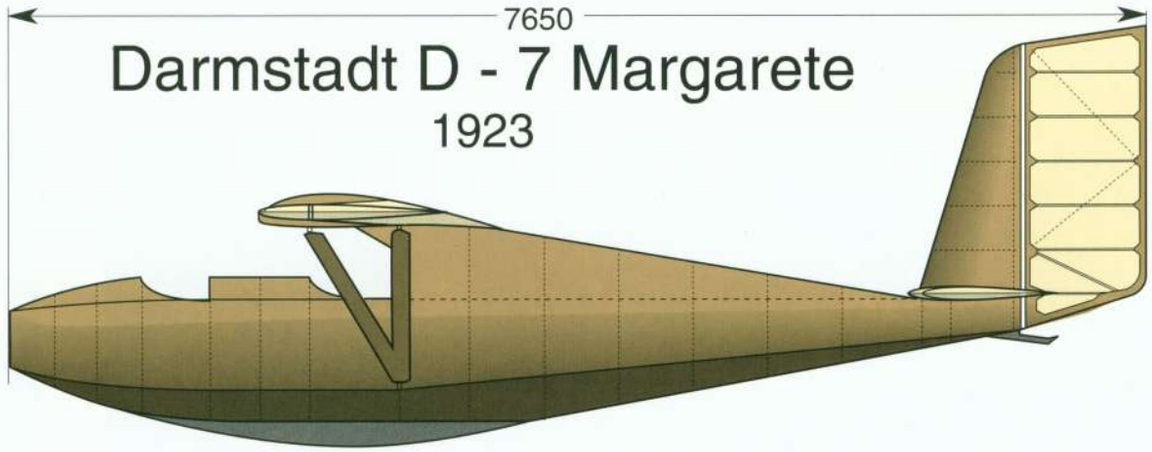
The Margarete gave outstandingly good service for several years. It was used for passenger carrying but, apparently, rarely or never for training new pilots. It was written off in 1927 when Johannes 'Bubi' Nehring, flying solo, was landing on the Wasserkuppe and an aileron cable broke. The sailplane was wrecked but Nehring was not hurt.

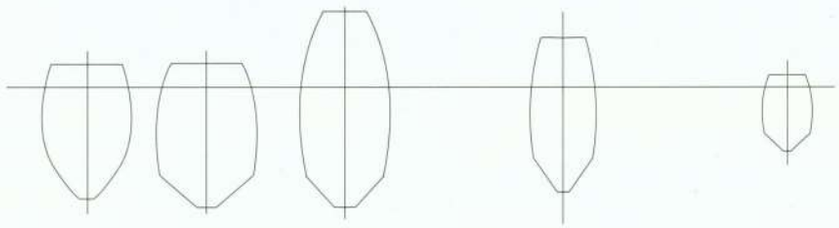
Konsul

The D - 9 was designed chiefly by Albert Botsch and Rudolf Spies, with advice from the best aerodynamicist of the student group, Fritz Hoppe. Financial help came from Karl Kotzenberg, the wealthy 'uncrowned king' of Frankfurt, who had funded the first Wasserkuppe competition. He had been Consul General to Norway and the new sailplane became, in his honour, Konsul.

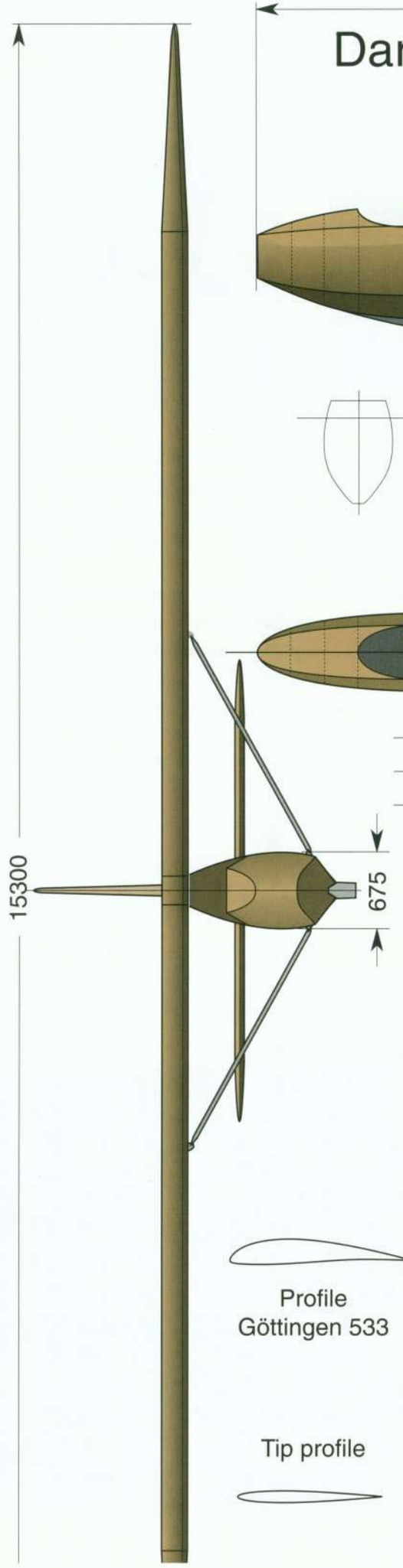
The Konsul flew in 1923, the most advanced sailplane of the time. It established all the main features required for an excellent soaring performance. The wing span, 18.6 metres, was far greater than any

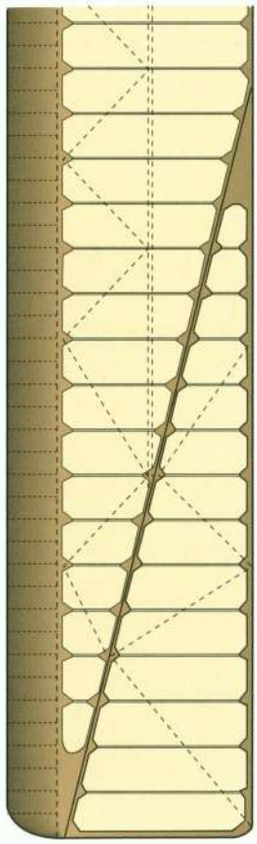
Darmstadt D - 7 Margarete
1923





Structure 180 kg
In flight 320 kg
Wing area 25 sq m
Wing loading 12.8 kg/sq m
Aspect ratio 9.36





Profile
Göttingen 533

Tip profile

Original
ailerons

previous sailplane and the resulting aspect ratio, 16.66, more than any preceding aircraft of any kind. There was a single strong, cantilever wing spar, with stressed plywood skin leading edge, now the obligatory structure for any advanced sailplane. The fuselage was a carefully streamlined semi-monocoque shell of lozenge shaped cross section, enclosing the pilot except for his head and shoulders. The tail surfaces were very large to provide stability. The best materials available were used, high grade timber and plywood, steel fittings and bolts, rubber blocks for springing the landing skid, cables running over pulleys for the controls and light linen fabric to clothe the open framework areas, behind the spar on the wing, and the entire tail unit. Clear dope made the fabric taut and airproof, then everything was varnished to a brilliant gloss to reduce skin friction in the air.

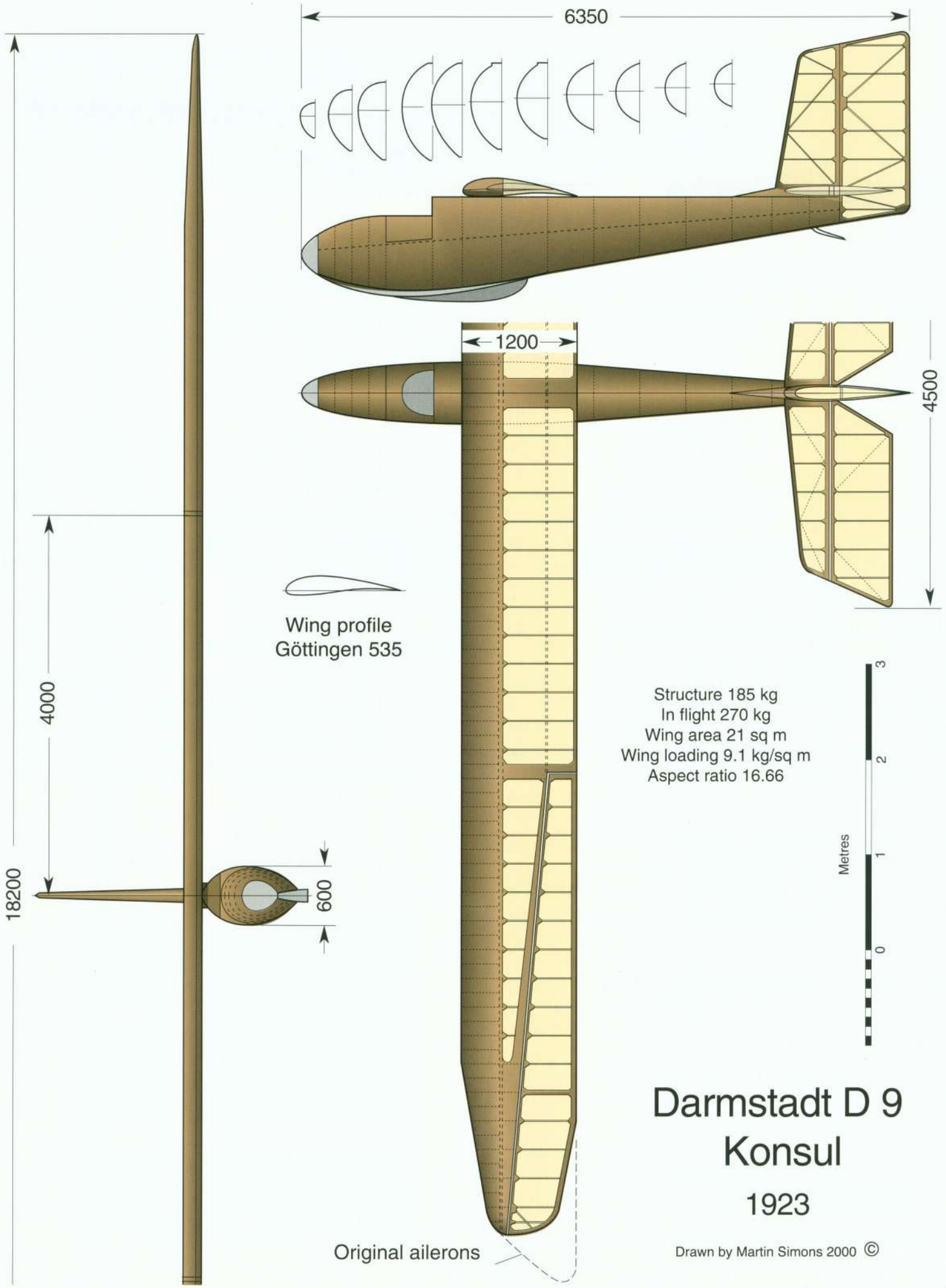
The aerofoil section chosen for the mainplane was the Göttingen 535, a shape recently developed and tested in the wind tunnel at Göttingen where the world's leading aerodynamicist, Ludwig Prandtl, headed the University Department of Aeronautics. This profile, developed along mathematical lines suggested by the pioneer Russian theorist Nicolai Joukowsky, had a streamlined teardrop form of 16% thickness (relative to the chord) curved around a camber line of 5.75%. The large camber ensured low profile drag at soaring trim. The Gö 535 became, for at least another fifteen years, a most popular sailplane wing section.

The Konsul was expected to have a very low minimum rate of sink and would be capable of using even weak slope lift. The huge control surfaces were heavy to operate but they were effective. On the ground the extended aileron tips were vulnerable to damage. After early tests they were reduced in size, cutting the total wing span down to 18.2 metres and the aspect ratio to 15.8.

An altimeter and airspeed indicator were mounted face up on the fuselage decking ahead of the cockpit. Variometers were unknown.

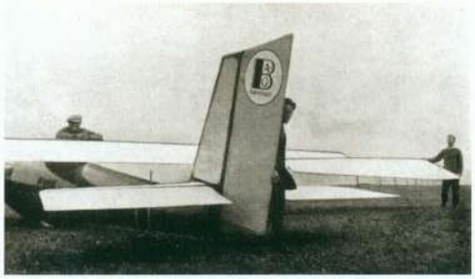
Above: Otto Fuchs flying the Konsul in 1924.

Below: Getting the sailplanes up to the Wasserkuppe was not easy. A large team of helpers drags the Konsul up the track on its trailer.



Darmstadt D 9 Konsul

1923



Left: Such a long wing needed a large vertical tail to provide some 'weathercock' stability for the Konsul. The very large rudder, which must have been heavy for the pilot to operate, was needed to counteract adverse yaw of the vast ailerons.

Right: The Württemberg in flight.

Pilots judged their rates of ascent or descent by reference to the hill slopes over which, and sometimes perilously close, they were expecting to fly.

All the hopes of the Akaflieg were realised. Botsch, one of the designers, flew the Konsul to a new distance record of 18.7 kilometres at the 1923 Rhön. The sailplane won the distance prize again in 1925 with a new, brilliant young pilot, Johannes 'Bubi' Nehring. On the excursion to the Crimea Nehring again broke the record, only just set by Martens in the Moritz, with a flight of 24.4 kilometres.

These were all hill soaring flights. A slope producing lift was followed as far as possible, then a glide was made across the gap towards the next hill. If sufficient height remained and the wind still blew, the new slope would be used to regain height, then a glide was made to the next likely place arriving usually far below the crest, and so on, often skimming within a few metres of trees or rocks until the pilot could find no more favourable slopes and must turn away to land in the valley. The Konsul continued in use for two further years until broken beyond repair by an inexperienced pilot in 1927.

By this time, the Darmstadt students had established a regular school of design producing a whole string of new sailplanes, each one an improvement on the last in some respects but all owing a debt to the Konsul. By accepting orders from private individuals or clubs, the Akaflieg became partly self supporting financially. In the interests of manoeuvrability and lightness on the controls, spans were reduced usually to about 16 metres. The Westpreussen, Schloss Mainberg and Starkenburg were designed by Heinrich Hofmann, the Lore and Württemberg by Paul Laubenthal, and so on. Other designers copied them. All followed the same basic layout with a cantilever wing of high aspect ratio in three pieces. The rectangular centre section was mounted above a streamlined fuselage, sometimes raised on a narrow pylon. The wing tip panels, carrying the ailerons, had a more or less elliptical plan, and were attached with steel bolts to the centre section, any gap closed with simple plywood fairings. To control stalling and reduce the danger of spinning at the stall the profile changed gradually to the tip with washout (negative twist). The tail control surfaces were generally of the all moving type, avoiding the drag associated with hinges. There were no trim tabs or air brakes. The cockpit was open but often fitted with a canopy to leave only the pilot's goggled head exposed. The undercarriage was a simple skid, usually made from laminated ash, rubber sprung and faired with strips of canvas.

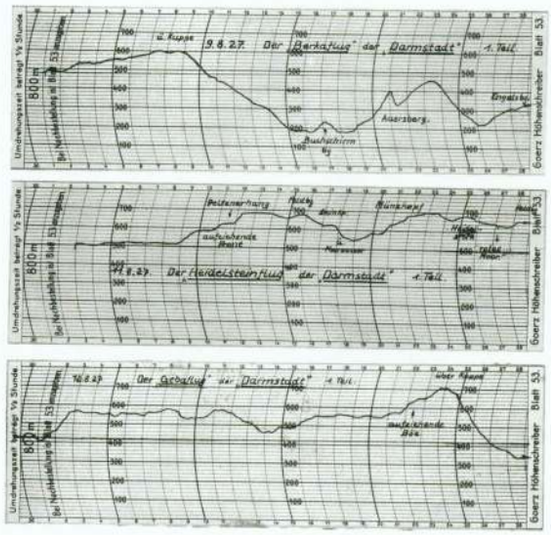
Württemberg

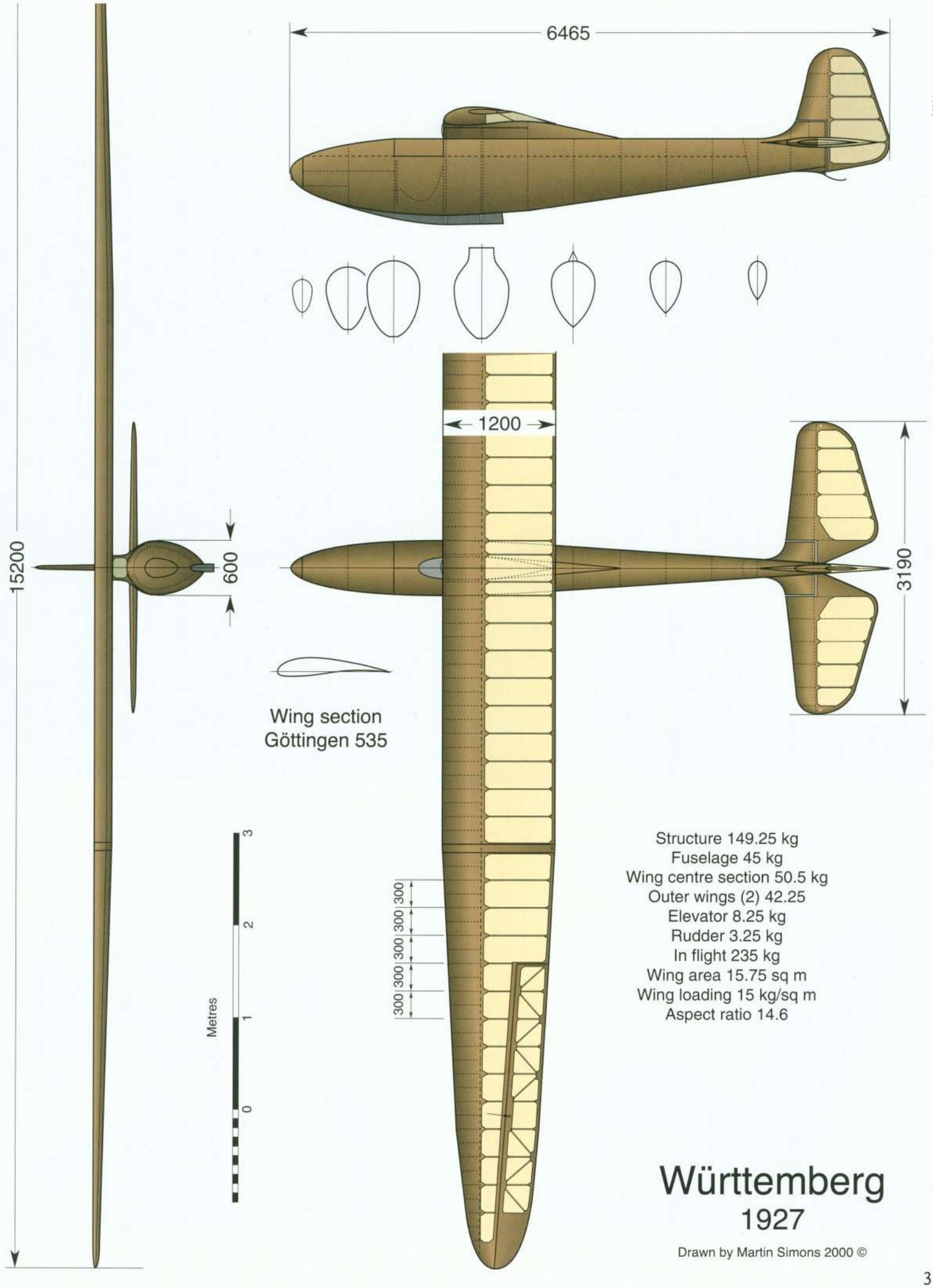
Wolf Hirth used the Württemberg, named after his home town, to win the French contest in Normandy, at Vauville west of Cherbourg, in 1928. He made a record distance flight along the coastal cliffs and dunes. After take off he climbed through 'sea fret' fog to re-enter clear air above, then flew along the coast, even pushing out over the sea, to a landing in sunlight on a public bathing beach.

Darmstadt D - 17 and 'Chanute'

The new sailplanes were not always built in the Akaflieg workshops. Volker's D - 17 Darmstadt was constructed professionally. Completed in time for the 1927 Rhön, Nehring used it to make a remarkable, hill soaring distance flight of 51.8 km. He had spent many hours studying contour maps and, given the right wind, knew just where to go to find the next lift.

Barograph trace for three of Nehring's hill soaring cross country flights in the Darmstadt D - 17.



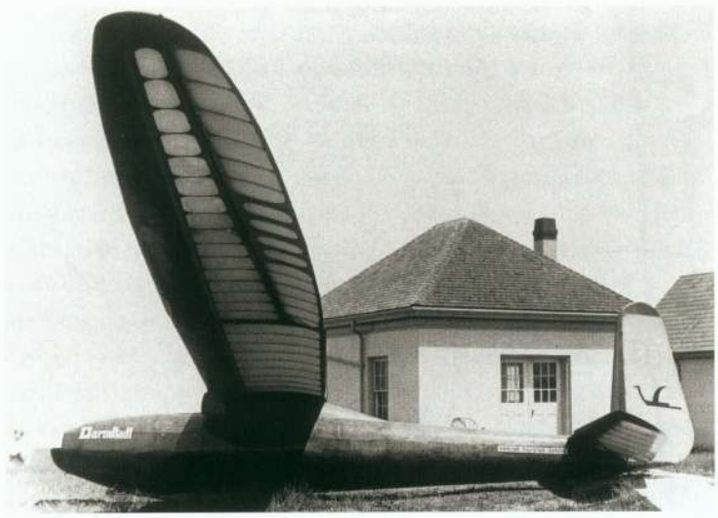


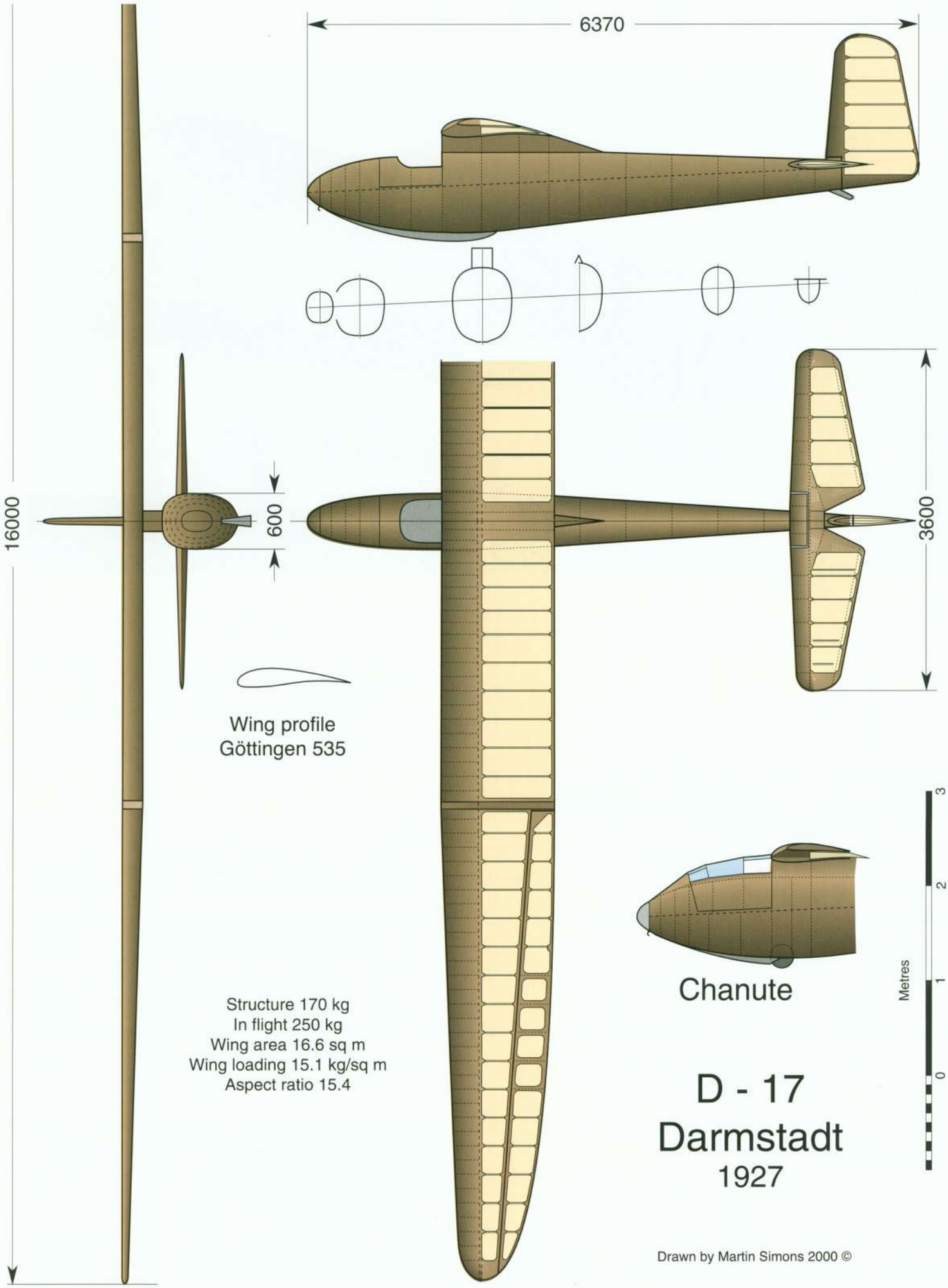
Structure 149.25 kg
Fuselage 45 kg
Wing centre section 50.5 kg
Outer wings (2) 42.25
Elevator 8.25 kg
Rudder 3.25 kg
In flight 235 kg
Wing area 15.75 sq m
Wing loading 15 kg/sq m
Aspect ratio 14.6

Württemberg
1927

Above and left below: The D - 17, Darmstadt 1, showing the structure of the wing and ailerons, large vertical, all-moving rudder carrying the Darmstadt school's emblem. It made its contest debut at the Wasserkuppe in 1927 after the destruction of the Konsul.

Right below: After the demonstrations at Cape Cod in April - May 1928 and serious damage to the sailplane there, the Darmstadt 1 was rebuilt and re-named 'Chanute'. It was given an enclosed cockpit. The pilot who flew it most was Jack O'Meara. The photograph here shows Richard du Pont and Mrs Holderman.



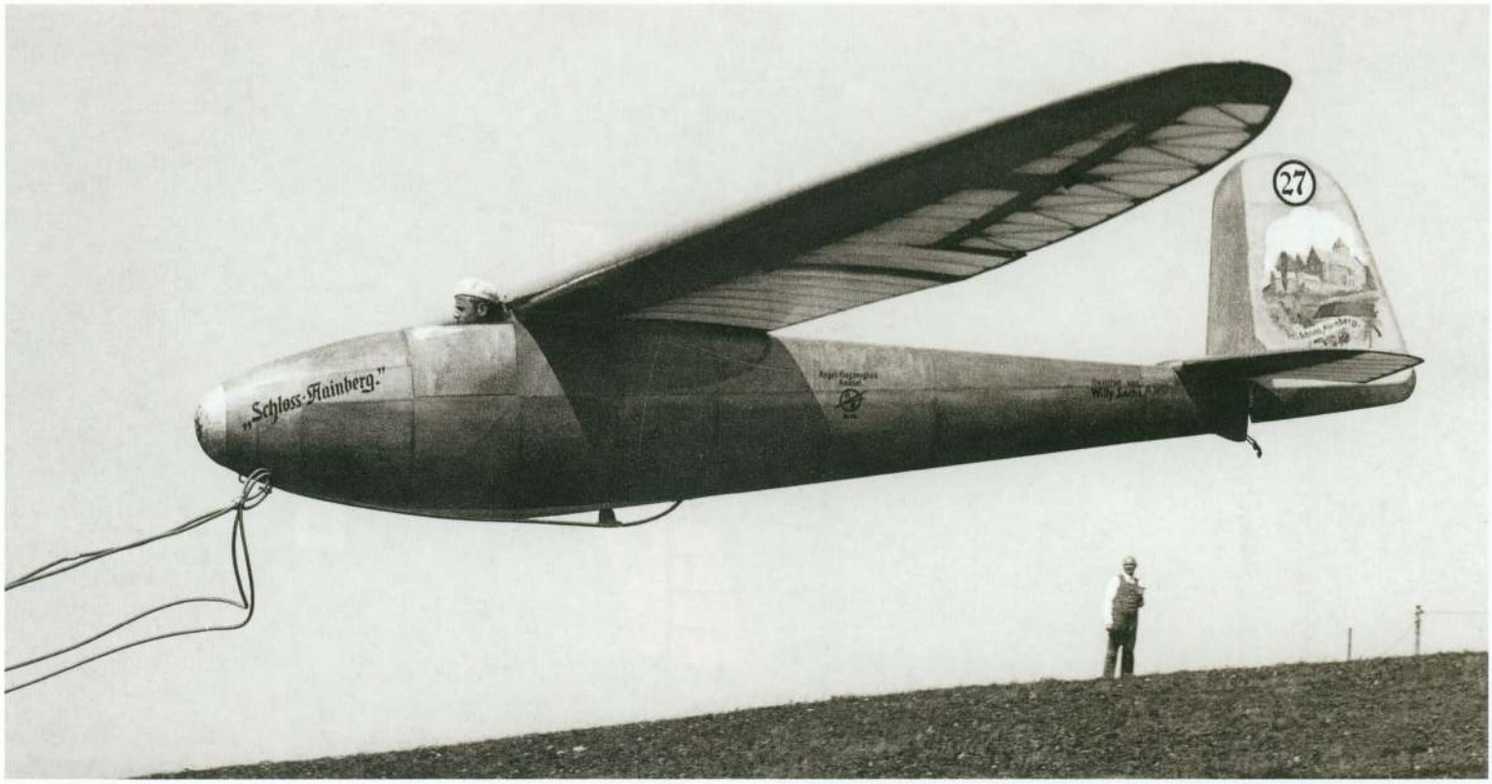


Wing profile
Göttingen 535

Chanute

Structure 170 kg
In flight 250 kg
Wing area 16.6 sq m
Wing loading 15.1 kg/sq m
Aspect ratio 15.4

D - 17
Darmstadt
1927



The Schloss Mainberg, a typical sailplane of the Darmstadt school. It went to the USA where, after being used for some years, it was destroyed in an accident.

A few months later, in 1928 the Darmstadt was taken to Cape Cod where Peter Hesselbach soared the dunes, on a flight extending to four hours. This attracted much attention in the USA, including that of the young Schweizer brothers who began to think seriously of building a glider themselves. The D - 17 was badly damaged in a mishap at Cape Cod, Hesselbach striking an unseen flagpole. The wreck was sold and rebuilt with improvements to the cockpit and an enclosed transparent canopy. Re-named Chanute, it was subsequently flown extensively by Jack O'Meara, the leading American pilot at the time.

The Westpreussen was originally built with a small span of 14 metres for Ferdinand Schulz who used it to explore the Baltic coast of East Prussia around Rossitten north of Königsberg, making distance by following the sand dunes, often almost touching the slopes with his wing tip, sometimes forced to land if confronted with fence posts or beached yachts with masts in the way. With the span increased to the more usual sixteen metres Westpreussen type was built in some numbers for sale, one being flown in England for several years.

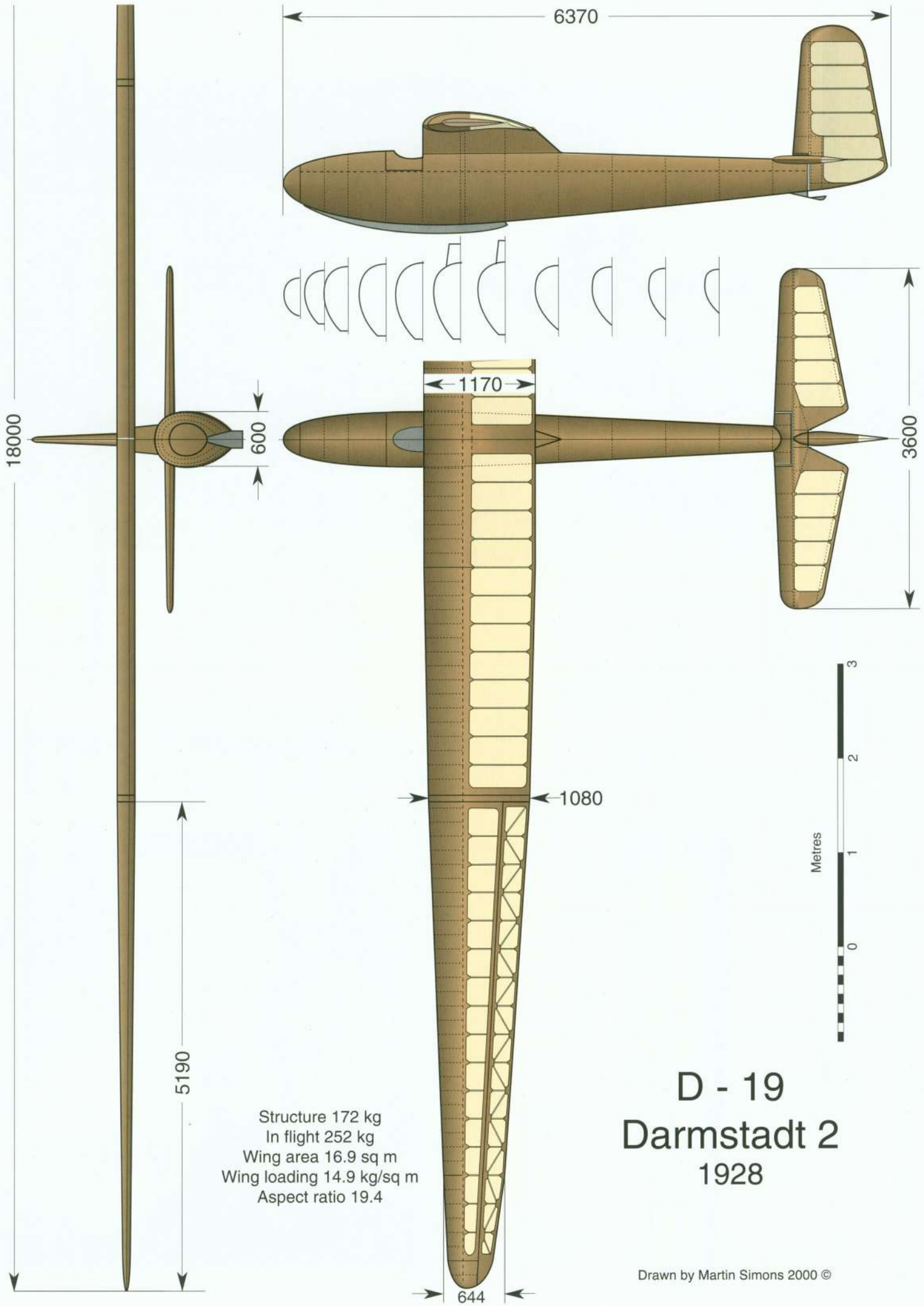
D - 19 Darmstadt 2

The D - 19 Darmstadt 2 of 1928 reverted to the large wingspan of 18 metres. The aspect ratio was 19.2, very impressive and rarely equalled even in the following decade. With new Joukowsky wing profiles which had less camber, and hence a smaller pitching moment than the Gö 535, the wing tapered in thickness from 15 at the ends of the centre section, to 8% at the wing tips. Nehring used this very superior aircraft to compete in the French championships and, at the next Wasserkuppe meeting, made a distance record of 71.2 Kilometres, still skimming over the slopes. The following year he managed 72.3 kilometres. The Darmstadt 2 continued in service until wrecked during an expedition to Sweden and Finland in 1934.

Musterle

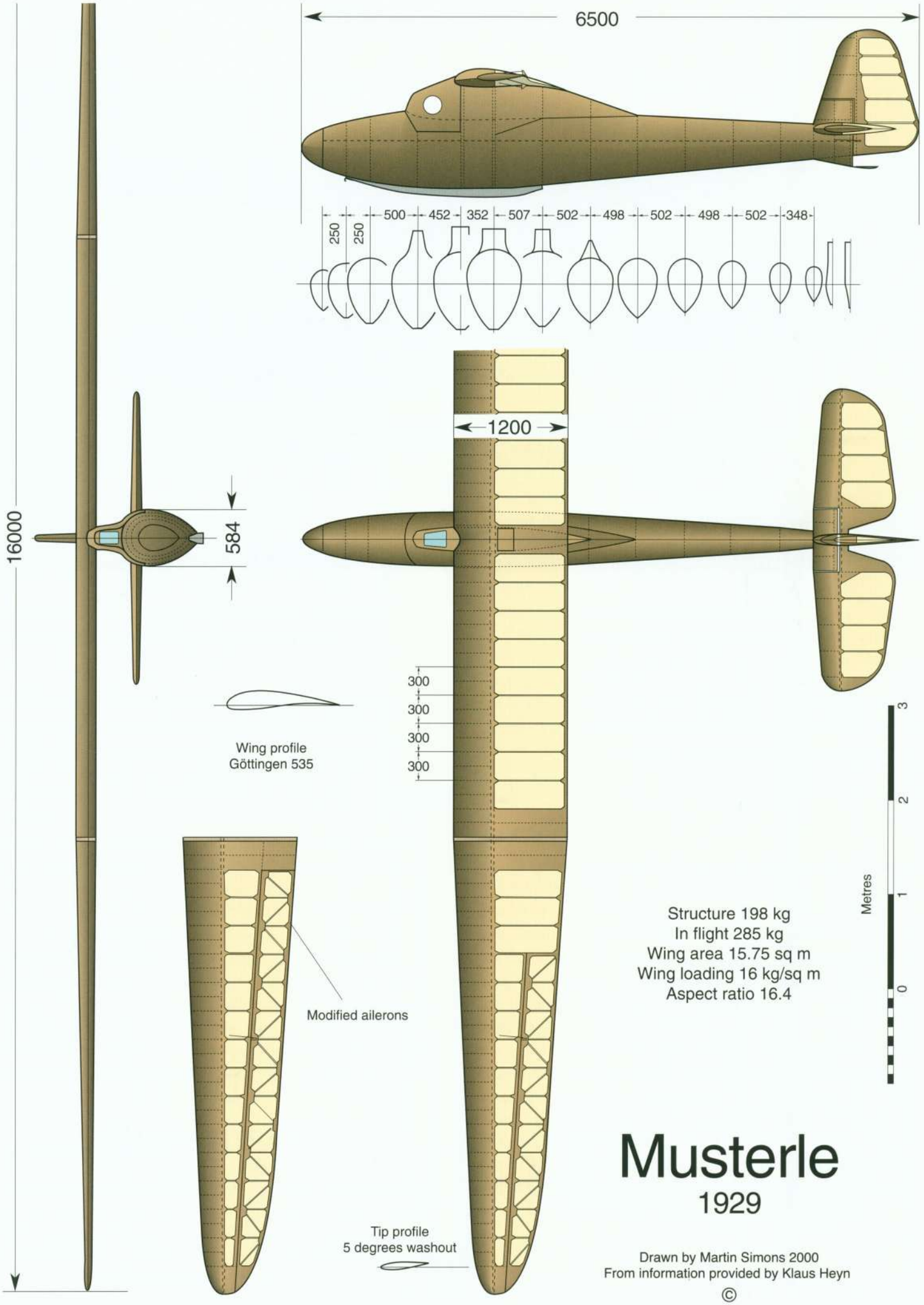
Most famous of all the Darmstadt types was the Musterle. This, built in Kassel for Wolf Hirth, was a copy of the Lore designed by Laubenthal. It had an enclosed canopy of wood, with minimal portholes for the pilot to see through, a small transparent windscreen in front and a tiny window above. Hirth took the Musterle to America in 1930 and competed in the US National Championships at Harris Hill, Elmira in 'upstate' New York. Unknown to the other pilots, he had a variometer. On October 5th 1930 he made a thermal soaring flight under a cloudless sky across country. Such a thing was unheard of. Up currents under, and inside, cumulus clouds had been used in Germany for several years before, but the existence of 'blue' thermals was hardly known even there. The Schloss Mainberg (which once flew a duration over 9.5 hours at the Wasserkuppe, landing in the dark) was also at Elmira for this contest, imported by Gus Haller who had established his own sailplane factory in Pittsburgh. He did some work on the Musterle for Hirth, extending the ailerons.

Hirth remained in the USA for several months and with the Musterle made a soaring flight over New York City on 10th March



Structure 172 kg
In flight 252 kg
Wing area 16.9 sq m
Wing loading 14.9 kg/sq m
Aspect ratio 19.4

D - 19
Darmstadt 2
1928



Structure 198 kg
In flight 285 kg
Wing area 15.75 sq m
Wing loading 16 kg/sq m
Aspect ratio 16.4

Musterle
1929

Drawn by Martin Simons 2000
From information provided by Klaus Heyn

Above: The Musterle, most famous of the early Darmstadt series, launched from the Wasserkuppe.

Below: Wolf Hirth displays the rudder of the Musterle, on which some of his earlier successes were listed. Not all were flown in this sailplane.

1931. He was bungee launched from a grassed area of Riverside Park, near the end of 161st Street, into a good north westerly wind. The Hudson River bank here was 30 to 35 metres high and gave adequate slope lift, which Hirth used to climb, at his best, to about 300 metres. He cruised over the river bank for half an hour but landed when the police signalled that he was creating serious traffic disruption. (He was not the first to fly a glider over the city for Jack O'Meara had done so, in a Franklin Utility, from an aero tow, a month before [see chapter 23].)

Darmstadt school sailplanes survived well into the 'thirties. At the 1934 Rhön the D - 19 Darmstadt 2 competed for the last time, two of the Westpreussen type and both the Musterle and the Lore were there. Musterle, no longer flown by Hirth, was broken badly in a misjudged landing, but repaired overnight. Another survivor was the original Württemberg. By the 1934 meeting, having passed through various hands and now suffering from serious glue failure, it was patched up by Tassilo Proppe, who used numerous external 'tack strips' of plywood with small steel nails to reattach the plywood skin on the wing to the ribs from which it had separated. In this condition he flew the sailplane successfully until, after a heavy landing, the damage was too extensive to repair.

By this time the sport of soaring had been entirely transformed by the discovery of thermals and new design trends were well established.

CHAPTER 3

Learning to Fly

If the sport of soaring was to flourish, new pilots must be taught to fly. Almost all successful flights in the early years on the Wasserkuppe were by pilots already experienced in powered aircraft, most of them veterans of wartime. Some youngsters such as the Darmstadt students who achieved fame, including Laubenthal, Nehring and Hesselbach, learned to fly in powered aircraft first. The Akaflieg had two aeroplanes and a very skilled instructor, Otto Fuchs, was available.

Germany was going through a disastrous period of runaway inflation and political instability. Ordinary folk could afford nothing beyond the bare necessities, a good many of the old and unemployed were truly starving. The only flight training scheme that had any chance of success, even with limited government finance, must be as inexpensive as possible.

To begin with, training was totally unorganised, haphazard and casual. Peter Riedel, a schoolboy of fifteen, in 1920 was towed along in his little biplane gently into wind by two helpers with ropes a metre long attached to the wing tips. Instructions were called to him by his volunteer instructor, Theo Suchla: Pull! Push! Pull, Right! Left, Pull! and so on. He made fourteen flights in this way.

Wolf Hirth had made a few tentative hang glider hops at the Wasserkuppe in 1920. From Messerschmitt's plans he built the S - 10. By a slow process of trial and error, towed off by helpers with ropes, he taught himself to fly. When confident enough, he undertook to teach others. A school was established by Messerschmitt with Hirth, and the S - 10 became the first glider used for systematic pilot training, solo. Messerschmitt soon closed his workshop on the mountain and left to build powered aeroplanes.

Kurt Student (who was later to become head of the German airborne forces in World War 2), also undertook to train pilots solo after the 1921 Rhön meeting, in cooperation with the Weltensegler Company. He was badly injured in a spinning accident and also departed. Among his earliest pupils had been Fritz Stamer who became a central figure in subsequent developments. Arthur Martens, with support from his wealthy father-in-law, also established a training school on the Wasserkuppe and took on Stamer, after Student had gone, as the chief instructor. The school had a two seat sailplane, the Deutschland, as well as the Strolch and Moritz for soaring. But Stamer was convinced that glider pilots could, and should, be taught to fly solo from the beginning, as he himself had been.

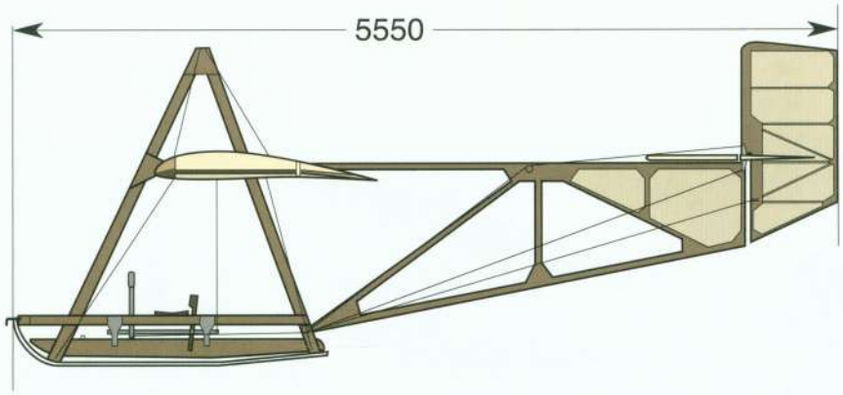
The original 'Djävlar anamma' or 'Hols der Teufel' designed by Lippisch. This was the basis of the Grunau 9 primary glider. Later versions by Schleicher and Jacobs also named Hols der Teufel, were really quite different.

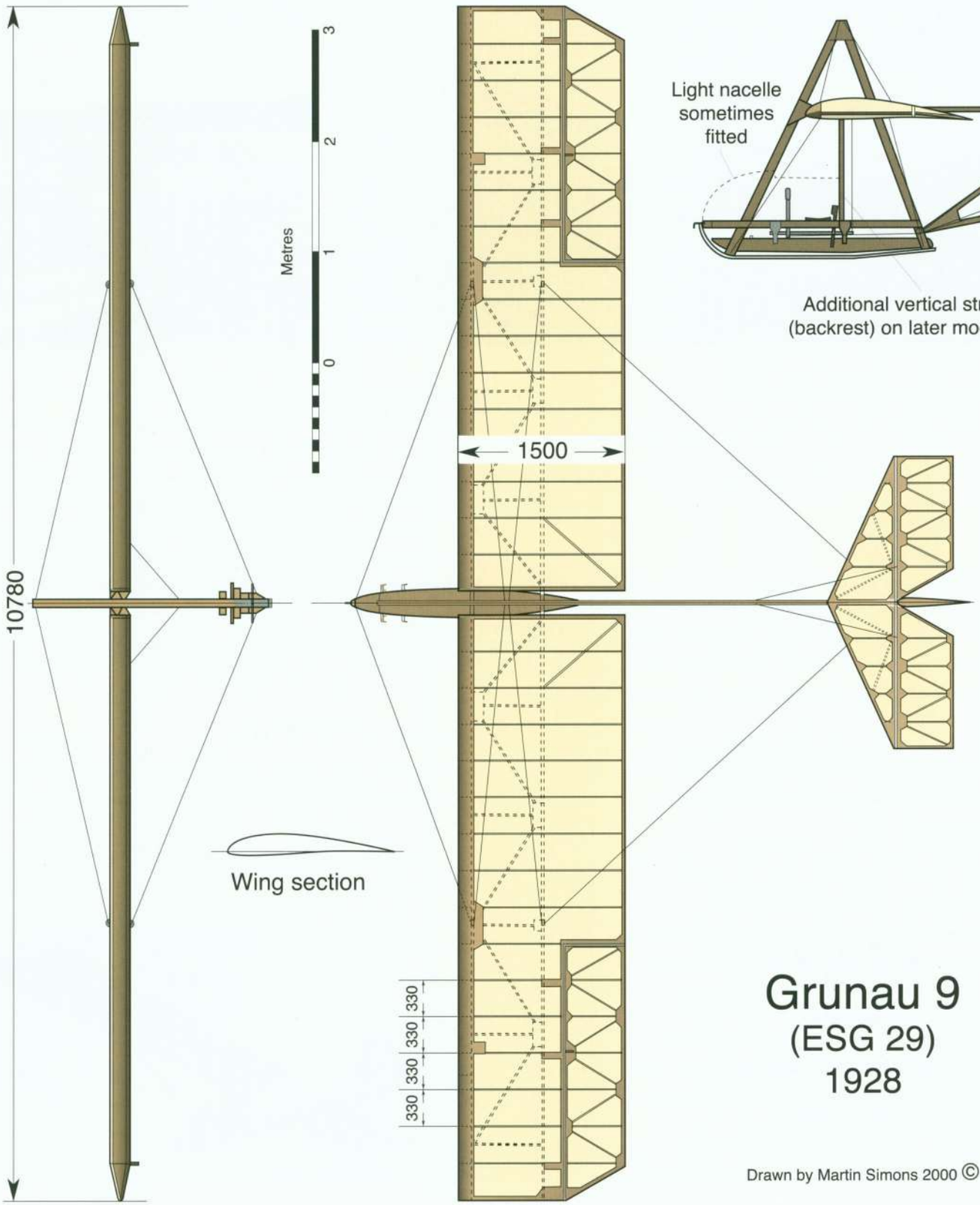
Djävlar Anamma (Hols der Teufel) and Grunau 9

In 1923 Alexander Lippisch had designed a very simple glider called Djävlar Anamma. This was an expression used frequently by two Swedish students who worked in the Weltensegler workshop and swore 'Devil take it' when anything went wrong. The name was daubed on the Lippisch glider. In German, the equivalent phrase was Hols der Teufel. The Djävlar had a simple two spar, rectangular wing, fabric covered, braced with wires to a very light but strong central 'A frame' structure which was extended rearwards with two cross braced longerons to take the tail. There was a simple wooden seat under the wing, within the A frame. The forward strut, promptly named 'skullsplitter', was immediately in front of the pilot's face. Lippisch designed a light fabric covered nacelle to enclose the cockpit and reduce drag.

Espenlaub, the woodworker, had designed and built several gliders and repaired many more. In 1923 he was invited to Grunau, a small village in Silesia, to help the growing gliding movement based there. Accompanied by Edmund Schneider he took with him the design for his own 'primary' glider, closely modelled on the Djävlar Anamma.

Structure 86 kg (approx)
In flight 150 kg (approx)
Wing area 16.06 sq m
Wing loading 9.3 kg/sq m
Aspect ratio 7.2
(Figures from 1930
Schneider catalogue)

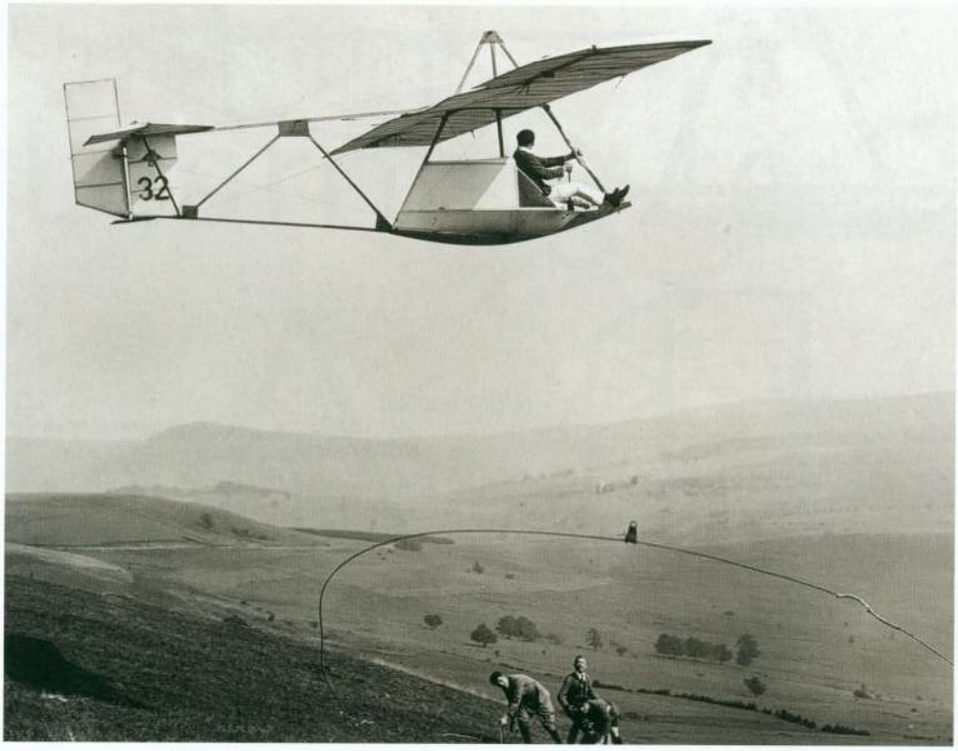


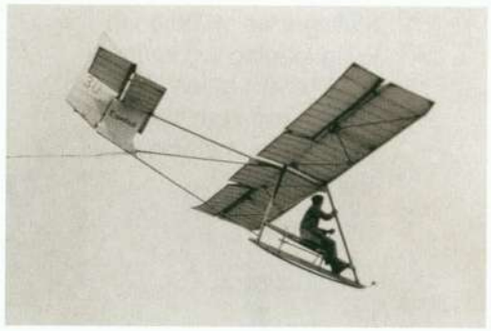


Additional vertical strut
(backrest) on later models

Wing section

Grunau 9
(ESG 29)
1928





Left: Pegasus, the father of all the later Primary gliders

Right above: The Espenlaub training glider which led directly to the Grunau 9

Right below: Later versions of the Grunau 9 had a vertical strut behind the pilot, with a back rest.

Edmund Schneider, a skilled woodworker, was a member of the Luftpolizei, an organisation responsible for security, safety and aircraft maintenance at the few operational airfields remaining in Germany. After a couple of years, Espenlaub left Grunau for Segelflugzeugbau Kassel. Schneider remained, married a local girl and set up a factory in the village below the hill where the gliding club was. He produced the ESG (Edmund Schneider, Grunau) primary glider which became the Grunau 9. This was produced in quantity and, with numerous small improvements over the years, was sold very widely.

It seems Schneider adopted a method of numbering his designs according to the year of their production. This still causes confusion. In some years more than one design appeared, so both had the same number. Sometimes an aircraft type which was produced over two or more years, would be allocated different numbers. The Grunau 9 itself was later called the ESG 29, various changes in detail having been introduced in that year. But there were other designs with the same number. These were also often given names. (Much later, in the nineteen thirties, a complete change in the system of nomenclature took place. The Grunau 6 and Grunau 8 were not related to the Grunau 9 or 29.)

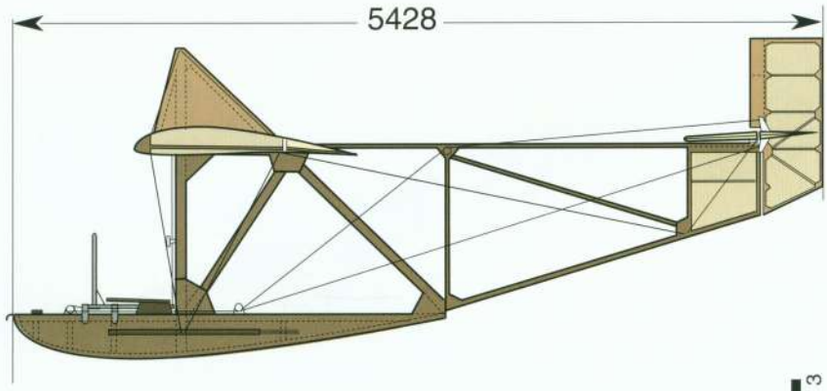
Stamer equipped the Martens school with primary training gliders called Pegasus, also based on the Lippisch Djävlar. Six of them were available by 1924. In August of this year the body that was to govern German gliding for most of the next decade was set up, The Rhön-Rossitten Gesellschaft, RRG. (Rossitten appeared in the title to acknowledge developments in East Prussia.) With government backing this organisation was made responsible for research, pilot training and competitions. The first official move towards organised training was to offer places at the Martens school for about fifty promising young people for the 1925 season. The school ran into financial difficulties. By the end of the year Martens was bought out completely by the RRG, who retained Stamer as the chief instructor.

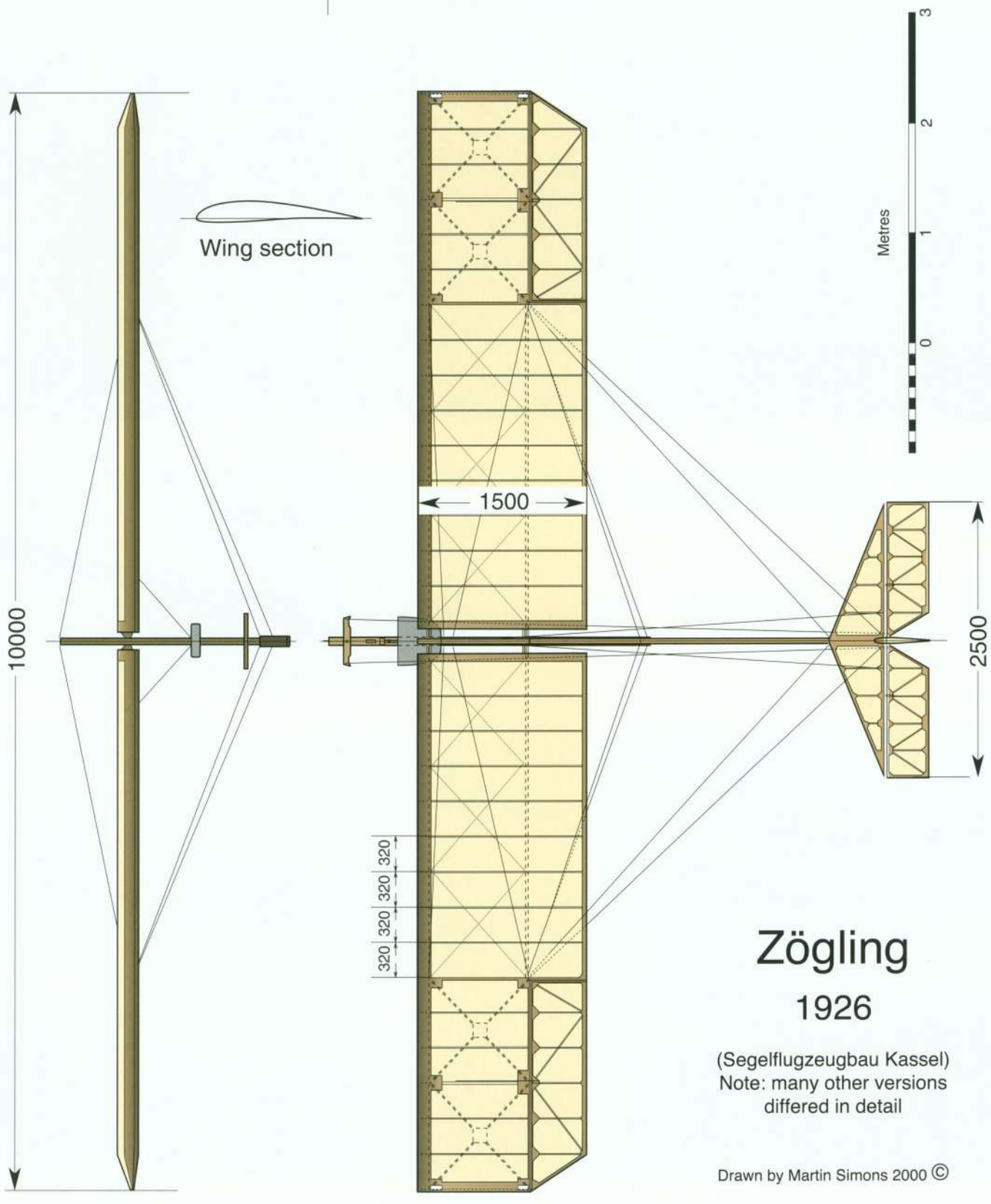
Zögling and Prüfling

At this point, Oskar Ursinus, whose self-imposed duties as contest director now passed to the RRG, once more took an initiative. The

The Prüfling, in effect a primary glider with a fuselage. The type was built in quantity by Segelflugzeugbau, Kassel.

Structure 86 kg
In flight 170 kg
Wing area 15 sq m
Wing loading 11.3 kg/sq m
Aspect ratio 6.7
(Figures quoted
by Gerhard Fieseler 1930)



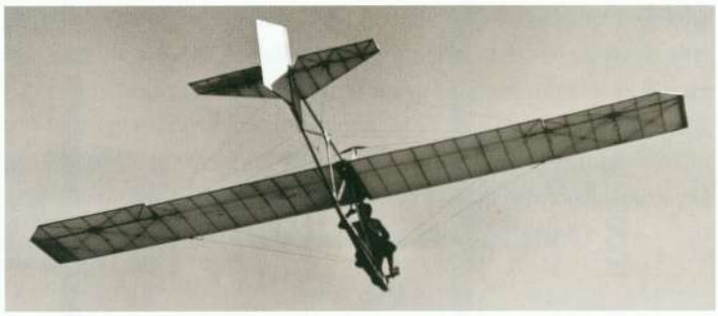


Zögling

1926

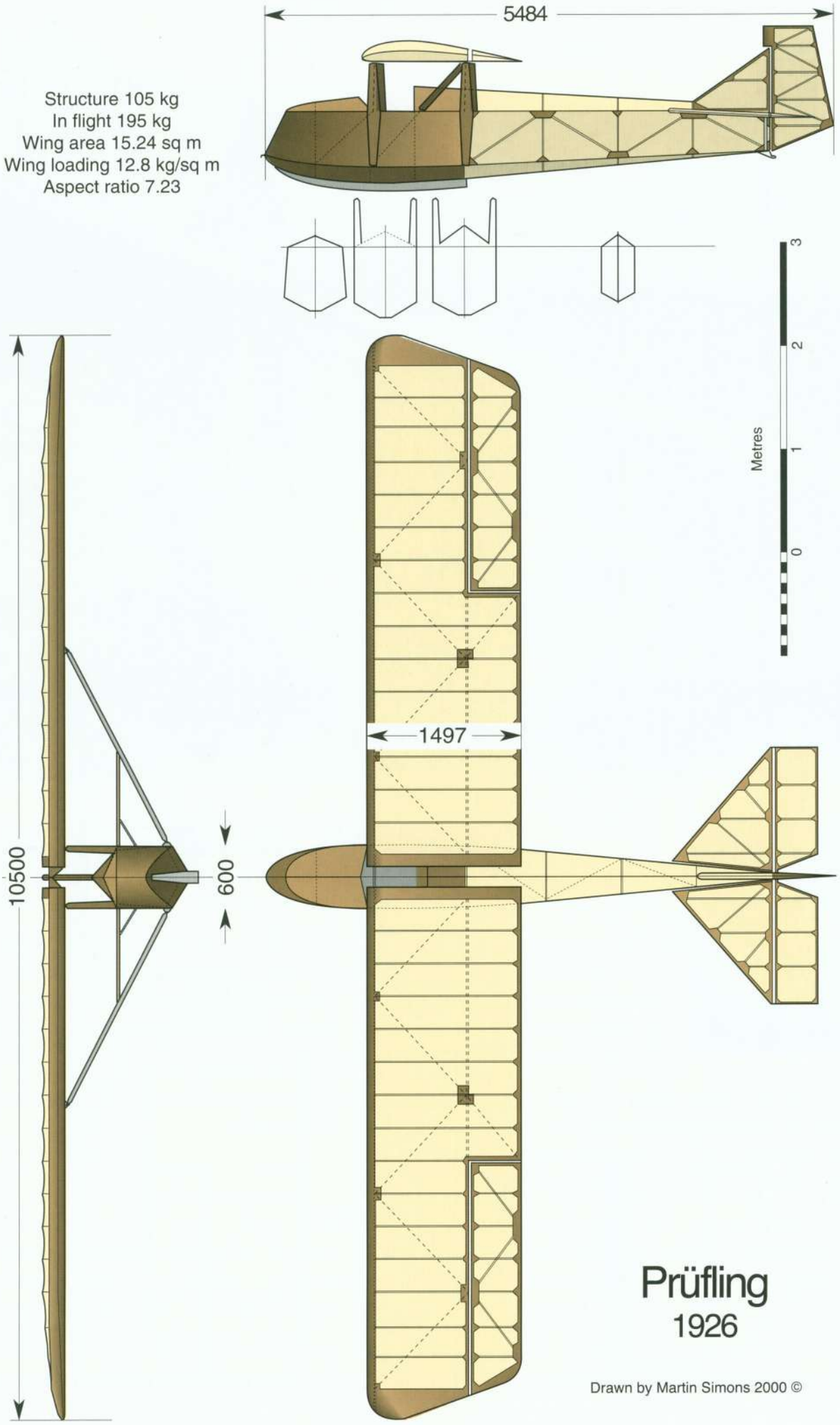
(Segelflugzeugbau Kassel)
Note: many other versions
differed in detail

Above: In England the London Gliding Club bought a Prüfling, seen here flying in a demonstration at Ivinghoe Beacon before the club found its permanent site nearer to Dunstable.



Right and below: The Zögling primary glider, widely copied all over the world.

Structure 105 kg
In flight 195 kg
Wing area 15.24 sq m
Wing loading 12.8 kg/sq m
Aspect ratio 7.23



Prüfling
1926

Above: The original English primary glider, the 'Dagling' marketed by the R.F. Dagnall company. The tail was carried on steel tubes.

Left: The 'Karpf' Zögling developed in Switzerland, with steel tube frame and enlarged tail. The light fairing behind the pilot improved the glide by reducing flow separation.

Pegasus gliders were not entirely satisfactory. The structure was somewhat flimsy and damage on a heavy landing frequent. Stamer did not like the skullsplitter strut, believing it was dangerous. Moreover, a future soaring pilot needed something better to fly once the basic skills had been learned. There should be a 'secondary' type after the primary, and beyond this, some cheap soaring sailplanes, 'intermediate' between the secondary and the advanced types. Ursinus invited Lippisch and Stamer to visit him in the offices of Flugsport in Frankfurt. Once there, they found themselves more or less kidnapped. Drawing office and accommodation were provided. They must agree on the design of a good primary trainer, then a 'secondary' which would lead later to an intermediate sailplane.

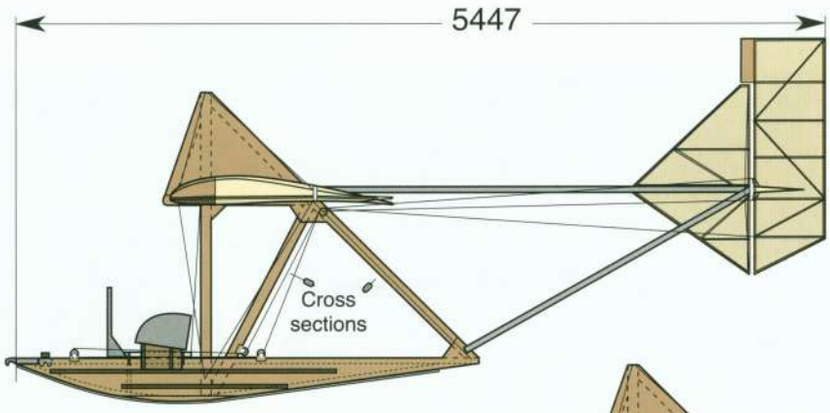
The result, within a few days, was the Zögling primary and the Prüfling secondary. The Zögling (Pupil) differed from the Pegasus chiefly in that the skullsplitter had gone, but it was stronger all round with a solid wooden keel, more able to stand the rough and tumble of training.

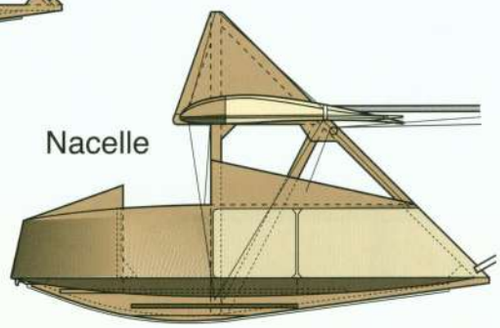
The Prüfling (Examinee), which emerged at the same time from the Flugsport offices, had almost the same wing as the primary, but a simple, plywood and fabric covered fuselage with cockpit underneath the wing. In 1926 the RRG accepted both the Lippisch gliders. Not only were they used in the schools on the Wasserkuppe and at Rossitten, but the plans were published and sold all over Europe and, before long, the world. Anyone could, with suitable materials and skill, build one.

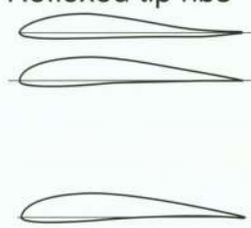
Dagling

When, in the late 'twenties and early thirties, gliding aroused the enthusiasm of aspiring aviators everywhere, innumerable imitations of the Zögling were designed and built. Plans for a version with steel tubes to support the tail were produced by Wolf Hirth. This design was taken up in Switzerland, America and England where it was called the Dagling. Plans for a Dickson Primary were

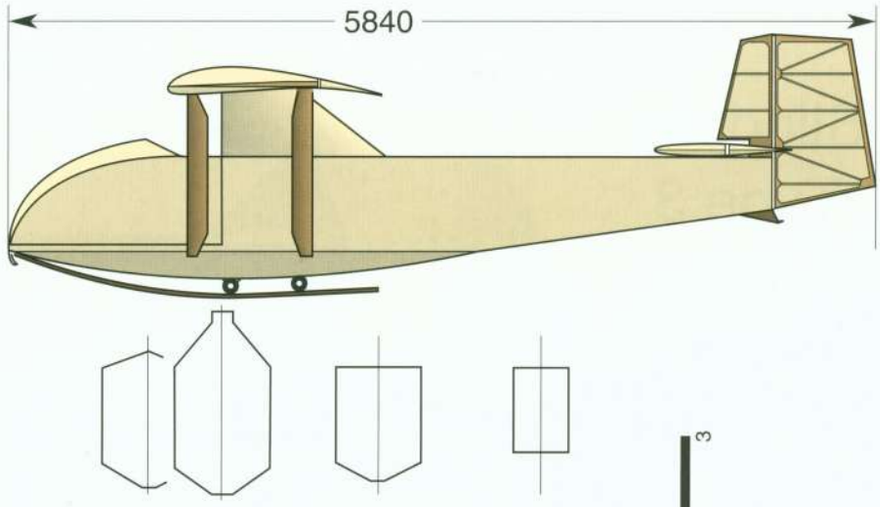
Slingsby Type 3 Primary
(Dagling)







Structure 82 kg
In flight 173 kg
Wing area 15.06 sq m
Wing loading 11.5 kg/sq m
Aspect ratio 7.1



Structure 110 kg
In flight 200 kg
Wing area 13.5 sq m
Wing loading 14.8 kg/sq m
Aspect ratio 7.4

Grüne Post
1932 - 3

Left above: The Dickson primary glider was popular with home builders who got the plans from magazines. As they soon discovered, the drawings contained errors but many examples were built and flown.

Left below: After Dagnall withdrew from glider manufacture, the Dagling was produced by Slingsby. Rounded wing tips were an option.

Right above: Grüne Post on display in Michelstadt/Odenwald.

printed with instructions in magazines. These were used by many clubs in the English speaking world, and so it went. For many years, if a newspaper needed a photograph to illustrate some story such as a great soaring distance or height record, the picture, ludicrously, would usually be a primary glider.

Grüne Post

In 1932 Lippisch designed for the sporting newspaper Grüne Post a small secondary glider very similar in size and appearance to the Prüfling and with similar performance. Plans could be obtained from the newspaper and many were built by amateur groups.

SG - 38

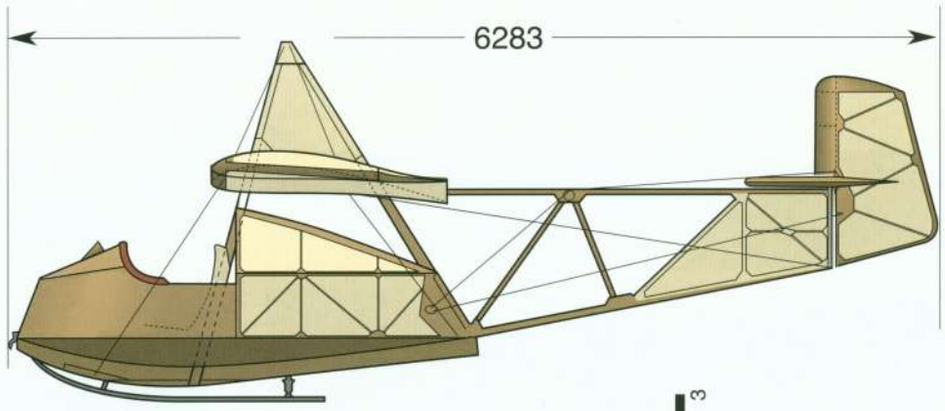
In 1933 the RRG was absorbed by the Deutsche Luftsport Verband, DLV. In association with the Hitler Youth movement, there was a vast expansion of glider training. Following lengthy discussions between the DLV and all the main glider manufacturers, a new standard primary trainer was designed, chiefly by Edmund Schneider, the Schulgleiter SG - 38. This was a considerable advance on the Zögling, with a larger tail for improved stability, a better seat and large shock absorbing springs under the keel. Manufacture, once begun, ran into many thousands. Every district of the Third Reich soon had its gliding unit and pilot training programme.

Along with the Zögling plans, went ideas and methods of solo pilot training worked out in detail by Fritz Stamer. Booklets and notes for instructors were published, Stamer's own book, Gleit und Segelflugschulung became a standard text and was translated into other languages.

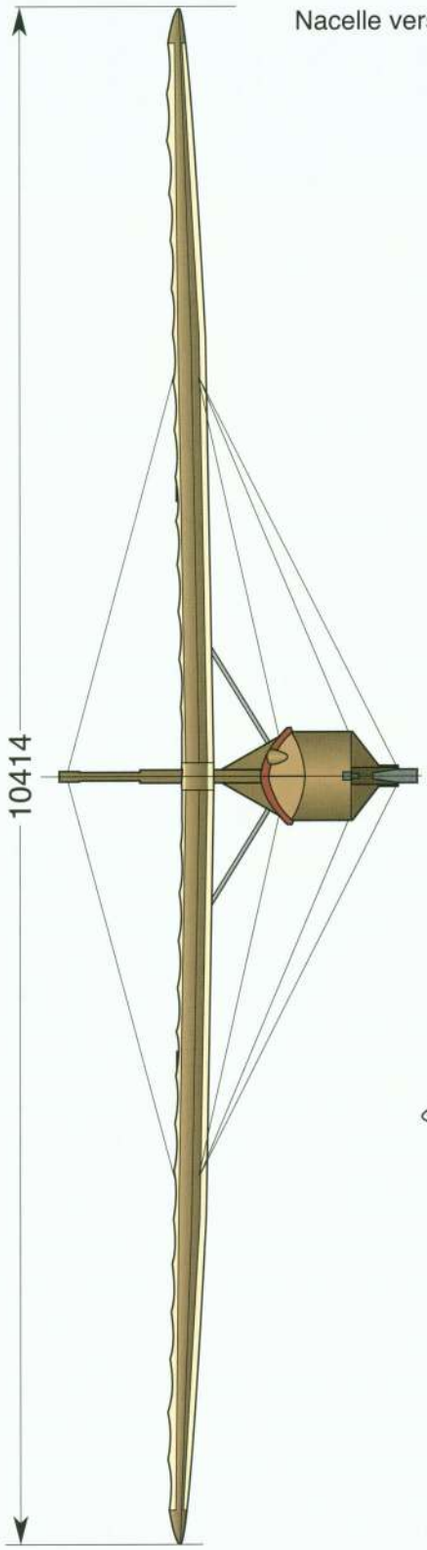
Solo training was used almost universally until after the Second World War. Stamer reported that in 1929, the RRG school accepted 269 student pilots. They were expected to spend their entire holiday of several weeks at least, on the mountain, working every suitable day with the Zöglings and the bungee, launching, gliding a little way, landing, dragging up the hill again, launching and so on. At the end of summer, 121 of the beginners completed the 'B' gliding certificate. That is, 45%, less than half, reached this minimal standard. From these successful ones, 30 or 11%, stayed for an extra month and achieved the 'C' five minute soaring, test. What became of all the others? A few might have returned next season. Most did not. These results were achieved with the best professional instructors in the world, with proper back up, workshops with skilled staff, and, all around for the students to observe, advanced aircraft and expert pilots demonstrating what might be achieved if they persisted.

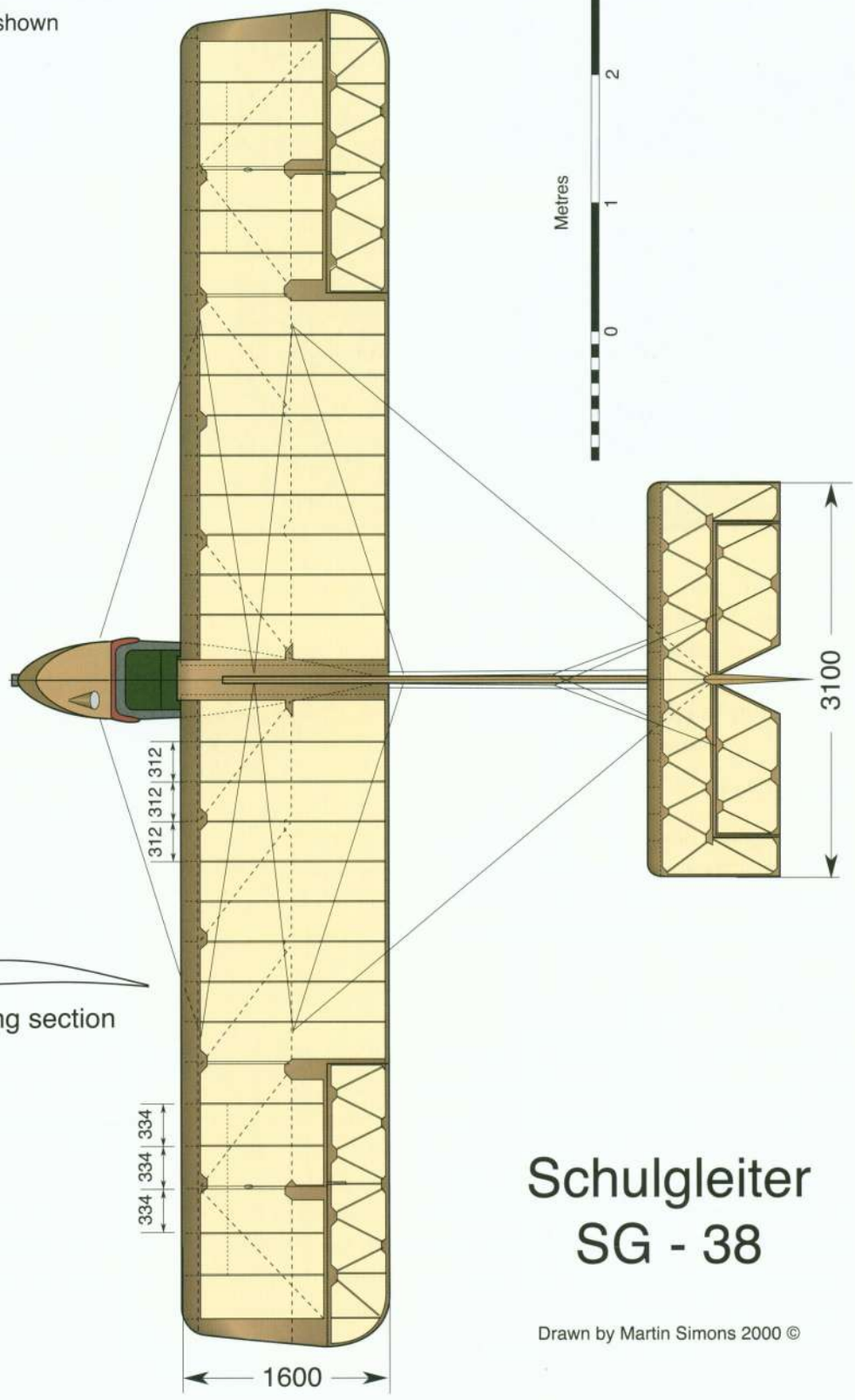
In the enormous majority of ordinary gliding clubs, there was none of this. Progress was pitifully slow. The instructors usually knew hardly any more than the pupils and were sometimes gravely misinformed. To mention only one point, the author's first flights were in a Dagling in 1947 when this type was still being

Structure 105 kg
In flight 210 kg
Wing area 16 sq m
Wing loading 6.6 kg/sq m
Aspect ratio 6.77



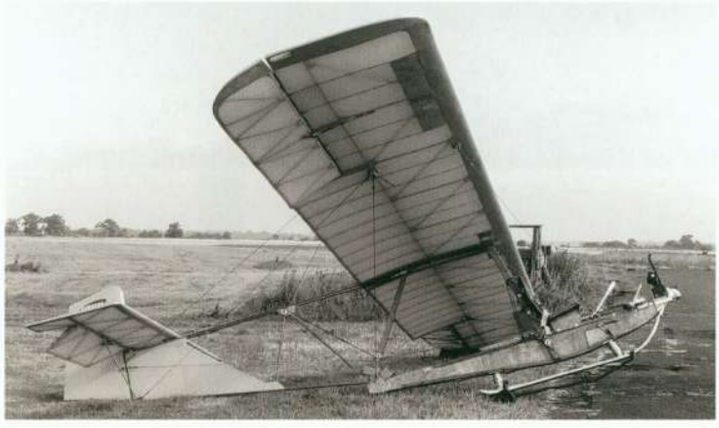
Nacelle version shown





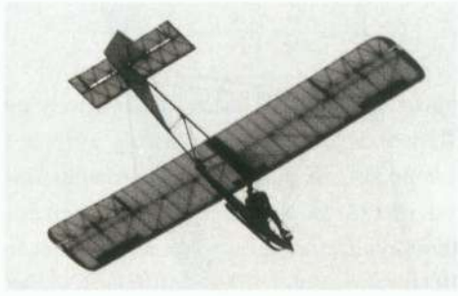
Wing section

Schulgleiter SG - 38



Above: A light nacelle was fitted to the S.G. 38 for the more advanced students. Note the crash helmet: standard wear for the NSFK.

Left and right below: The SG - 38, which entered mass production in 1938, was a great improvement on the Zögling. This restored example shows the large shock absorbers below the keel, the contoured seat, enlarged tail unit for increased stability, provision for basic instruments and attachment points for ballast to suit different weights of pilot.



used widely in English clubs. A lightweight schoolboy or girl would often get into, or rather, onto, the seat immediately after a fully grown, hefty adult. No one mentioned, no one even knew, that the resulting shift of the centre of gravity would make a very significant difference to stability and above all to the sensitivity of the elevator. The Dagling had no provision for trimming ballast anyway. There were many accidents, some of them fatal, some less serious, but all involving damage to the aircraft followed by long periods spent in repairs. The work usually was done by the, unskilled, club members themselves. (I taught myself to scarf plywood!) Minor crashes were not documented or investigated. Costs not only for materials and labour but revenue lost to the clubs, was extremely high.

Many potentially good pilots departed in sheer frustration. There were back and even neck injuries, not always immediately recognised. People left the gliding site with a pain and didn't come back. In England in a sudden wave of enthusiasm, nearly sixty gliding clubs were formed in 1930, all using solo training methods. A year later there were four or five. In Australia of nine clubs listed, one survived.

It is easy to be wise in retrospect. In power flying no one dreamed of solo training. Dual instruction was well established and understood. What would have happened to the soaring movement if, instead of the Zögling, Lippisch and Stamer had designed a training glider, just a little larger, with a second seat and controls for an instructor? It would have cost a little more than the single seater but would have lasted longer to earn its keep. Accidents would have been fewer, less time and money would have been spent on repairs, fewer students would have been frustrated, discouraged, frightened, injured, killed. More would have learned to fly. More would have learned to soar.

Was the Zögling a mistake from the beginning?

CHAPTER 4

The Rhön Ghost

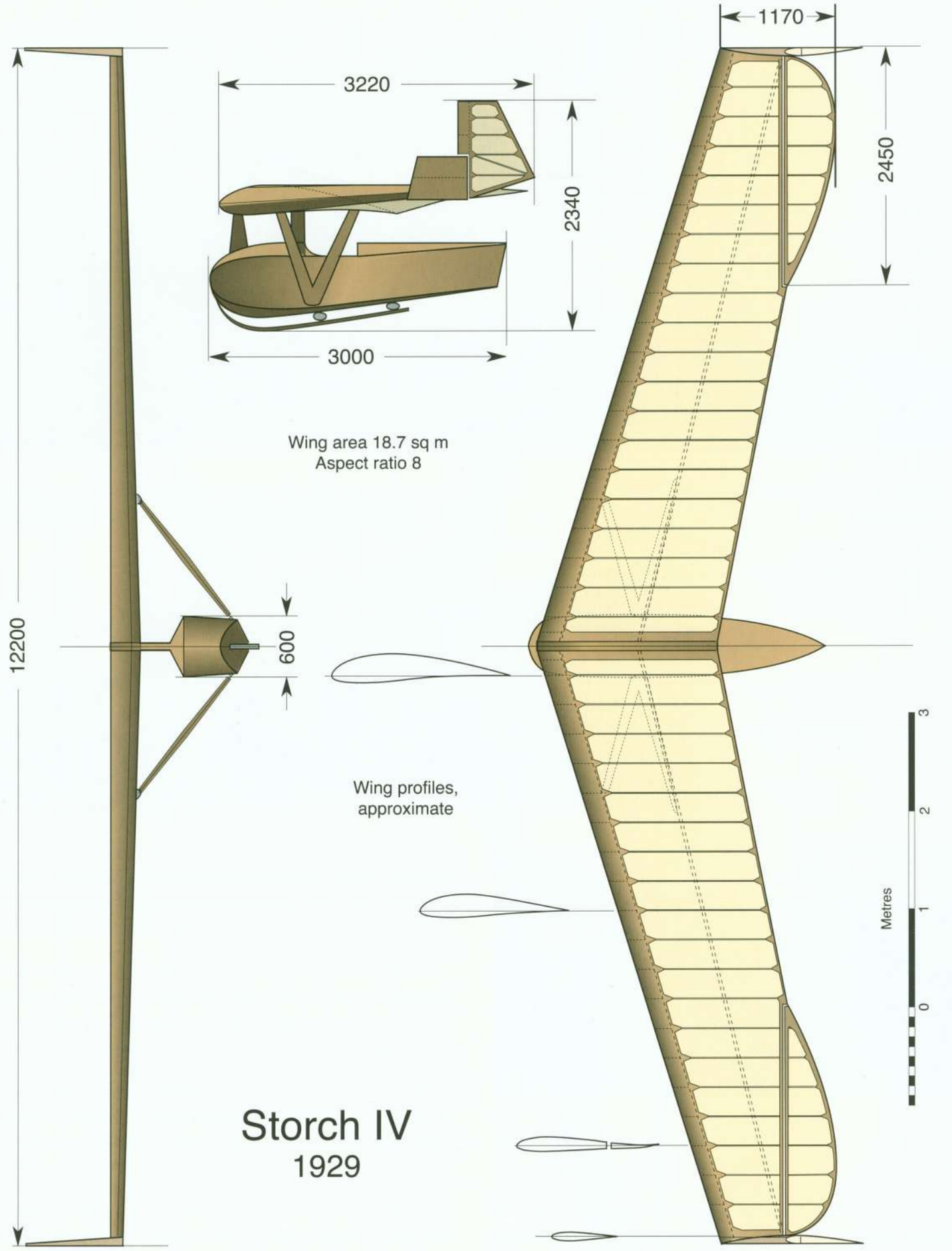
The Storch IV flew successfully over the sand dunes at Rossitten.

Alexander Lippisch had carried out research into wing profiles while working for Dornier during 1918 but when the German aircraft industry collapsed after Versailles, he was unemployed. In 1921 he answered an advertisement by a clerk in the Benz automobile factory, for an aircraft designer to produce a glider for the 1921 Rhön contest. The monoplane, called Falke, which Lippisch designed with the aid of some wind tunnel tests, was built in a furniture works in Fulda where Alexander Schleicher, a boy from the village of Poppenhausen, was an apprentice. The Falke went to the Wasserkuppe but crashed there, probably due to the inexperience of its pilot though Lippisch himself admitted that while the aerodynamic form was good, he had no experience of stressing. For both Lippisch and Schleicher nevertheless this was the beginning of a new career. Schleicher became a professional sailplane manufacturer in his home town, where the factory he established is still in business.

Lippisch was present when Wenk's Weltensegler crashed but was impressed by its apparent stability in the first minutes of its disastrous flight. He resolved to carry out systematic research into tailless aircraft. During the next year or two he spent so much time on the mountain alone that he was nicknamed the Rhöngeist (Rhön Ghost or Spirit). He built and tested many large tailless and some 'canard' models, often more than four metres wing span, using a simple catapult to launch them. He then designed a glider which was constructed by his friend Espenlaub, the Espenlaub E 2. It was of 10 metres span with swept back wings and 'elevons' for both lateral and pitch control. The wing profile was symmetrical to bring the pitching moment to zero. End plates were fitted under the wing tips after early flights, but the performance was disappointing and the plates were too readily damaged. They were changed to the upper side with better results.

Storch

Lippisch then was employed briefly by the Weltensegler firm, producing the famous Djävlar Anamma and working on other designs until the company failed in 1924. In 1925 he became head of the technical division of the RRG, with the old Weltensegler workshop at his disposal and accommodation in the Ursinus House, newly built on the foundations of the abandoned Messerschmitt shed. Work for the RRG diverted him from research, but in 1927 he pro-



Storch IV
1929

Drawn by Martin Simons 2000
©

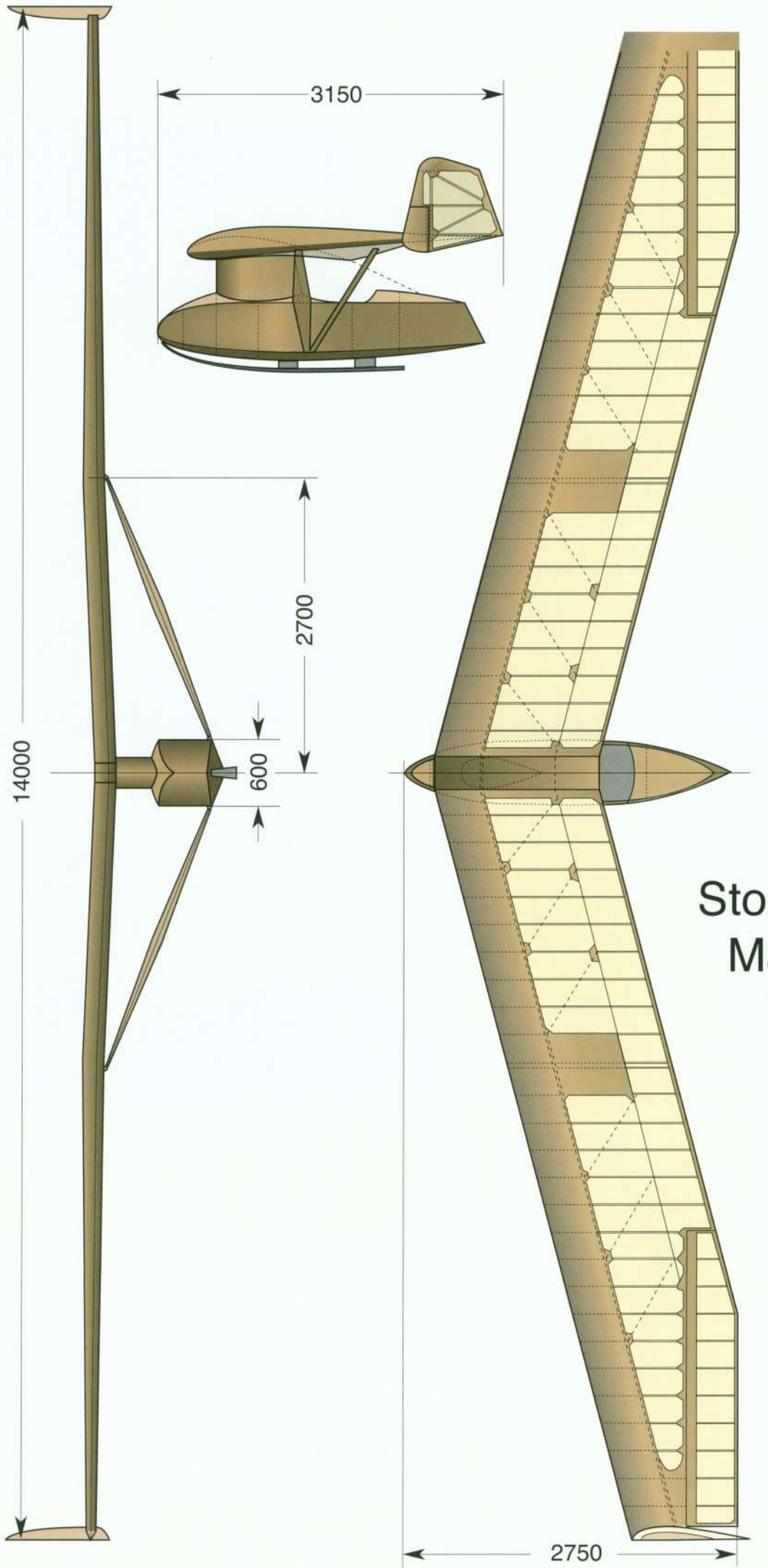
Above: The Storch II in flight - briefly - with Fritz Stamer the pilot.

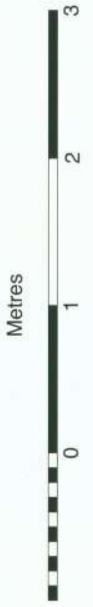
Right: The Storch V was fitted with a motor and flew well, encouraging Lippisch to continue with further work on tailless and delta aircraft.

Below: The Storch IV was the most successful glider of Lippisch's storch series. It was flown by Groenhoff, seen here on the right of the nose.

duced the first of the Storch tailless series, very similar to the old Espenlaub 2 but with 12.15 metre span. The wing had pronounced sweepback and generous dihedral, with tip end plates or winglets 'toed in' to assist stability in yaw. A yaw to the left brought the left winglet to aerodynamic zero, reducing drag, while the right winglet met the flow at a large angle, creating more resistance. The resulting forces tended to counteract the yaw. The wing profiles changed across the span from a normal cambered form in the centre to a reflexed section with washout at the tips. A streamlined pod hung on struts under the wing, housing the pilot.

The dihedral was found to be excessive. The winglets were redesigned and the Storch II appeared, which was an improvement. In 1928 the Storch III had the pod replaced by a hexagonal box sectioned capsule with a rearward extension to provide some central fin area. In the Storch 4 lobate ailerons were arranged with their hinge line at right angles to the flight direction. These proved much more satisfactory. The winglets were cambered inwards to create a side force (anticipating by decades the similar winglets developed by R T Whitcomb at NASA). The Storch IV flew well and was fully controllable. Lippisch fitted it with a small engine and, as the Storch V, it made many successful powered flights in 1929 before being crashed on Darmstadt aerodrome during a demonstration in very turbulent conditions.





Storch VIII Marabu
1932

Wing area 15 sq m (approx)
Aspect ratio 13 (approx)

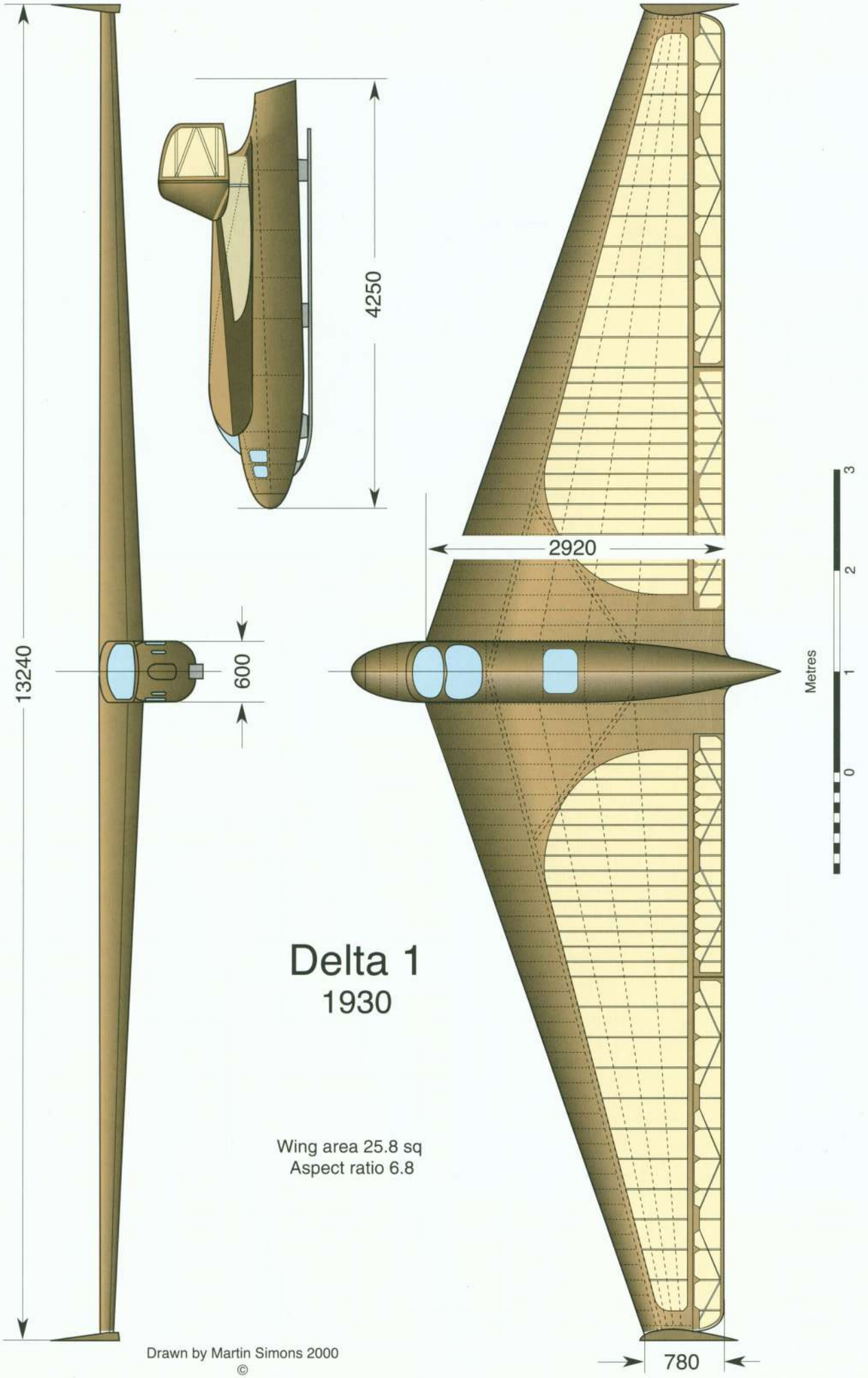
Above and right: Lippisch went on to develop many more tailless aircraft. The Delta I was test flown as a glider by Günther Groenhoff at the 1930 Rhön, though not competing. It was subsequently converted to power and flew in 1931. It was difficult to handle on take off and crashed severely in 1933.

Storch VIII 'Marabu'

A young trainee pilot, Ernst Philipp, had been much impressed by the flights of the Storch IV and determined to build his own tailless sailplane. With technical advice from Lippisch's office, he built and flew his Marabu or Storch VIII. Although this proved quite satisfactory in the air, the technical committee on the Wasserkuppe in 1932 would not let him fly it in any winds strong enough to allow hill soaring. In time for the following year's competition he built a detachable tailplane on an extended fuselage. The tail assembly could be removed easily and the Marabu flown in either configuration. Probably because adding the tail caused a rearward shift of the centre of gravity, the Storch VIII was more prone to spinning with the tail than without it. Nevertheless in this aircraft Philipp achieved his 50 km 'Silver C' distance flight. In trying to stretch the last few hundred metres of distance he arrived in tree tops, and clambered down a rope kindly thrown to him by workers in a nearby factory who had watched his arrival. The glider had to be rescued by the fire brigade but was little harmed.

Falke

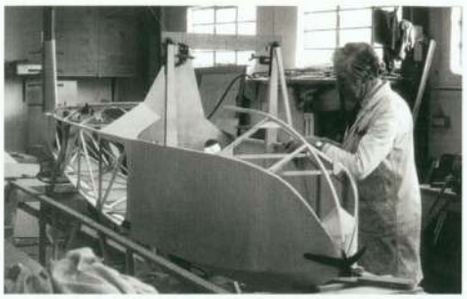
The Prüfling, Lippisch's 'secondary' glider design of 1926, had proved less than satisfactory. The performance of a Zögling when the pilot was faired with a light nacelle, as was often the case, was almost as good. The Prüfling did not handle very well either, lacking inherent stability. What was needed, Lippisch thought, was an extremely stable sailplane with very safe handling yet with a large enough span and light enough to give a low rate of sink. Nothing could be better, he supposed, than a Storch IV type of wing which had been proved stable in itself, but fitted with a fully orthodox tail unit to give even more stability. The result was the Falke which ap-



Delta 1
1930

Wing area 25.8 sq
Aspect ratio 6.8

Drawn by Martin Simons 2000



Above: Constructing a replica Falke in Ken Fripp's workshop at Lasham, England.

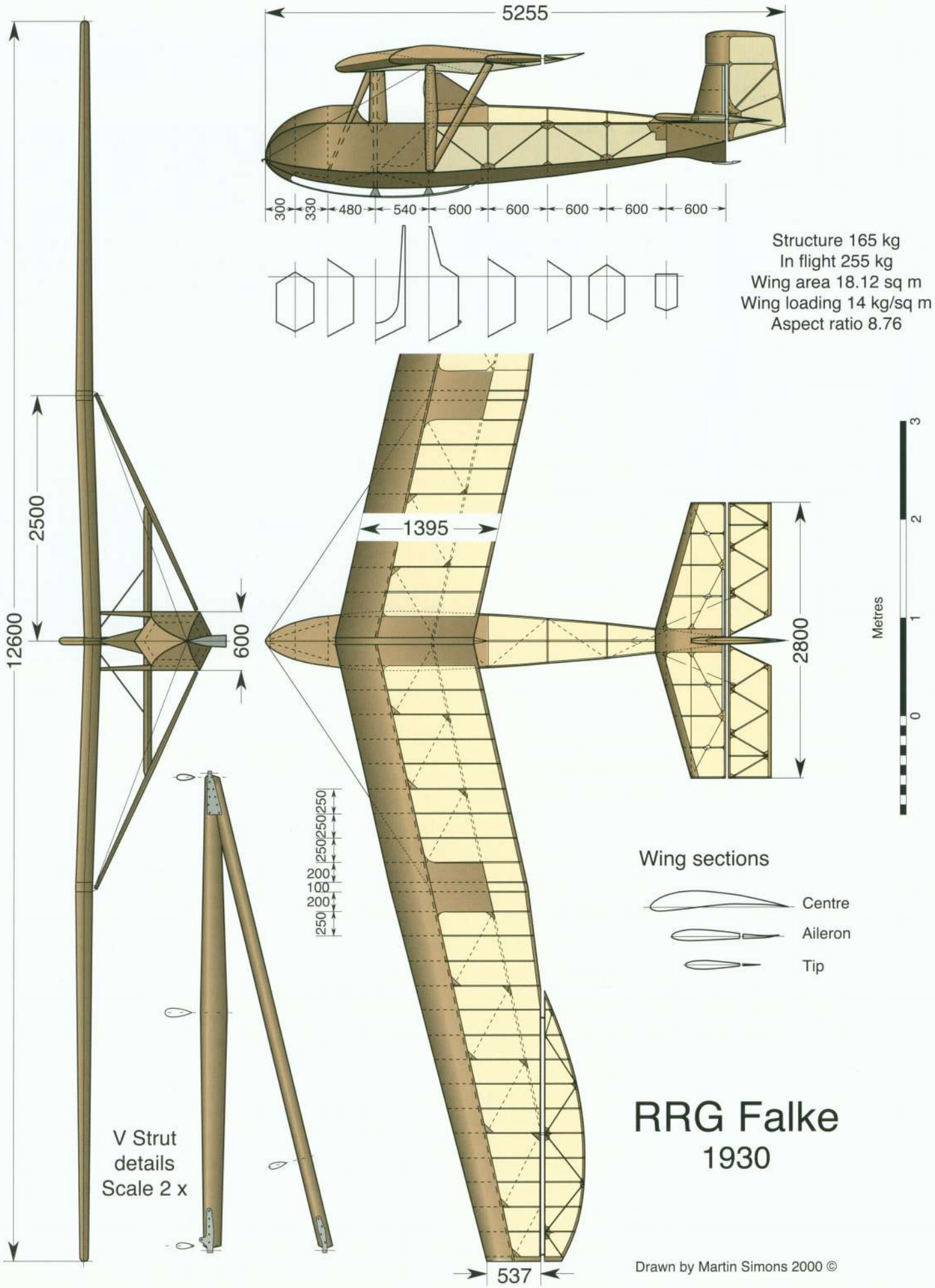
Right: The Falke, designed by Lippisch to be stable and slow for inexperienced pilots.

Below: Although intended as a simple trainer, building the Falke was difficult. It had swept back wings and a slightly cranked main spar. Even the fuselage had few straight lines.

peared in 1930. It was accepted by the RRG and, as was the custom, plans were made available for amateur and other constructors. The RRG itself before long had a dozen of the Falke type on call for the Wasserkuppe training school.

Among those who took up the Falke drawings, was Fred Slingsby in England, who produced nine under licence and, later, enlarged the design to make the two seat Falcon III. Schneider in Grunau and Schleicher also produced the Falke. An improved version, the Falke RVa with span enlarged and a different arrangement of the cabane struts, was developed in 1931. Still later, a Super Falke with a span of 16.88 metres was flown, but the type was by then quite out of date.

From these beginnings, while still involved with more orthodox sailplane design, Lippisch continued with research into tailless aircraft. With his design team he left the Wasserkuppe in 1934 when the RRG was dissolved and the technical section, which he still headed, removed to Darmstadt. It was henceforth the Deutsche Forschungsanstalt Für Segelflug, DFS, the German Research Institute for Soaring flight.



RRG Falke
1930

Drawn by Martin Simons 2000 ©

CHAPTER 5

Lippisch, Georgii and Thermal Soaring

Discoveries in 1928 changed soaring entirely and resulted in widespread interest. Despite the opinions of many eminent people, it was proved beyond doubt that sailplanes could use convection currents to soar. Gliding clubs and organisations sprang up all over the world. The developments also led gradually to a new breed of sailplane.

It had been supposed by many that if sailplanes were to fly for any length of time away from hill slopes, it must be by dynamic soaring. It is generally accepted that birds, especially the wandering albatross, carry out dynamic soaring in the lowest levels, or boundary layer, of the atmosphere, mostly below 30 metres. The bird gains energy by repeatedly passing from the slow airstream near the sea surface, up into the faster flow above and back again following a more or less circular orbit, diving downwind, turning steeply near the surface to face upwind again using the excess airspeed to pull up into the faster stream and climb, turning again to dive downwind and so on. The same kind of soaring is quite common with relatively small, highly manoeuvrable radio controlled model gliders, usually on the lee side of sharp, 'hogs-back', ridges where there is a sharply defined shear between two airstreams. The style of flying required, so near the ground, would be extremely dangerous for a full scale sailplane.

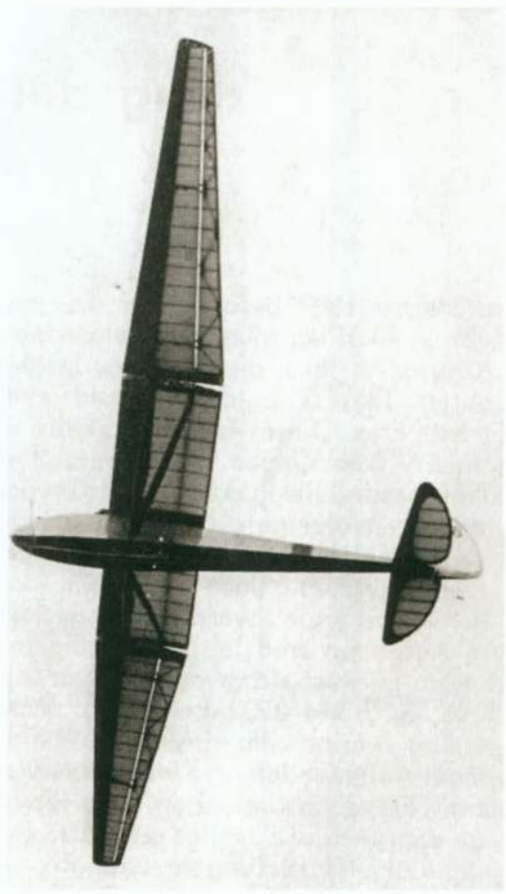
At greater heights, occasionally, it has been possible to maintain height by extracting energy from a shear layer where winds above and below differ markedly in velocity. This, however, is not a regular practice, because detecting such a wind shear is very difficult.

Even Professor Georgii, who in 1926 was appointed simultaneously to the chair of Flight Meteorology at the Darmstadt Technical University and head of the RRG Research Institute, had argued in 1922 that thermals must be too small and feeble for sailplanes. Had these opinions been correct, soaring would for ever have been confined to the hills, coastal cliffs and sand dunes. The entire movement would probably have vanished in the late twenties, especially since practical light aeroplanes were becoming popular.

Peter Riedel, posing proudly here, used the prototype Professor, called 'Rhöngeist' after Lippisch, for his first cross country flight, from Darmstadt to Frankfurt in 1932.

Yet there had been clear evidence of strong thermals before 1928. Many acute observers, ornithologists, meteorologists and plain folk with eyes in their heads, had seen birds gliding, circling and rising. Some scientific writers rightly deduced that they were using thermal currents. Cumulus clouds were good indicators of what was going on in the atmosphere. The published reports describing these things were missed or ignored. Like many others Georgii supposed that dynamic or gust soaring was the only possibility over level country.

At the Rhön contest in 1926, flying one of the earlier Darmstadt sailplanes, the D - 12 Roemryke Berge, Nehring soared for almost an hour over the Wasserkuppe after the wind had dropped to nothing. This was surely not slope lift although he treated it as such, flying beats up and down over the hill. Had he thought to make a few circles he would surely have astonished himself and everyone else. A few days later Max Kegel, an experienced power pilot flying a sailplane he had designed and built, very similar to the Darmstadt Westpreussen, found himself drawn rapidly up into a thunder cloud amidst rain and hail, barely in control. He was extremely relieved and lucky to be thrown out of the cloud at a height between 1500 and 1800 metres, landing, after a long glide down, in a field 55 km



Above: In the USA, two examples of the Professor were built under licence, and marketed under the name 'Haller Hawk' They remained in use for many years. Here Martin Schempp, who was living in America at the time, is in the cockpit.

Right: After the Prüfling came the Professor, capable of good soaring flights when flown skilfully.

from his take off. It was a world record distance but flown quite unintentionally. He was known afterwards as Gewitter Max (Thunderstorm Max). His account of the experience did not encourage others to emulate him.

It was not until the spring of 1928 that Georgii, based at Darmstadt Griesheim aerodrome, began to make systematic studies of convection. Johannes Nehring, under the professor's direction, flew a light aeroplane fitted with recording instruments under a series of promising cumulus clouds. With the engine throttled back or even switched off entirely, up currents of 4 and 5 metres per second were found. Georgii at last announced that convection soaring must be possible.

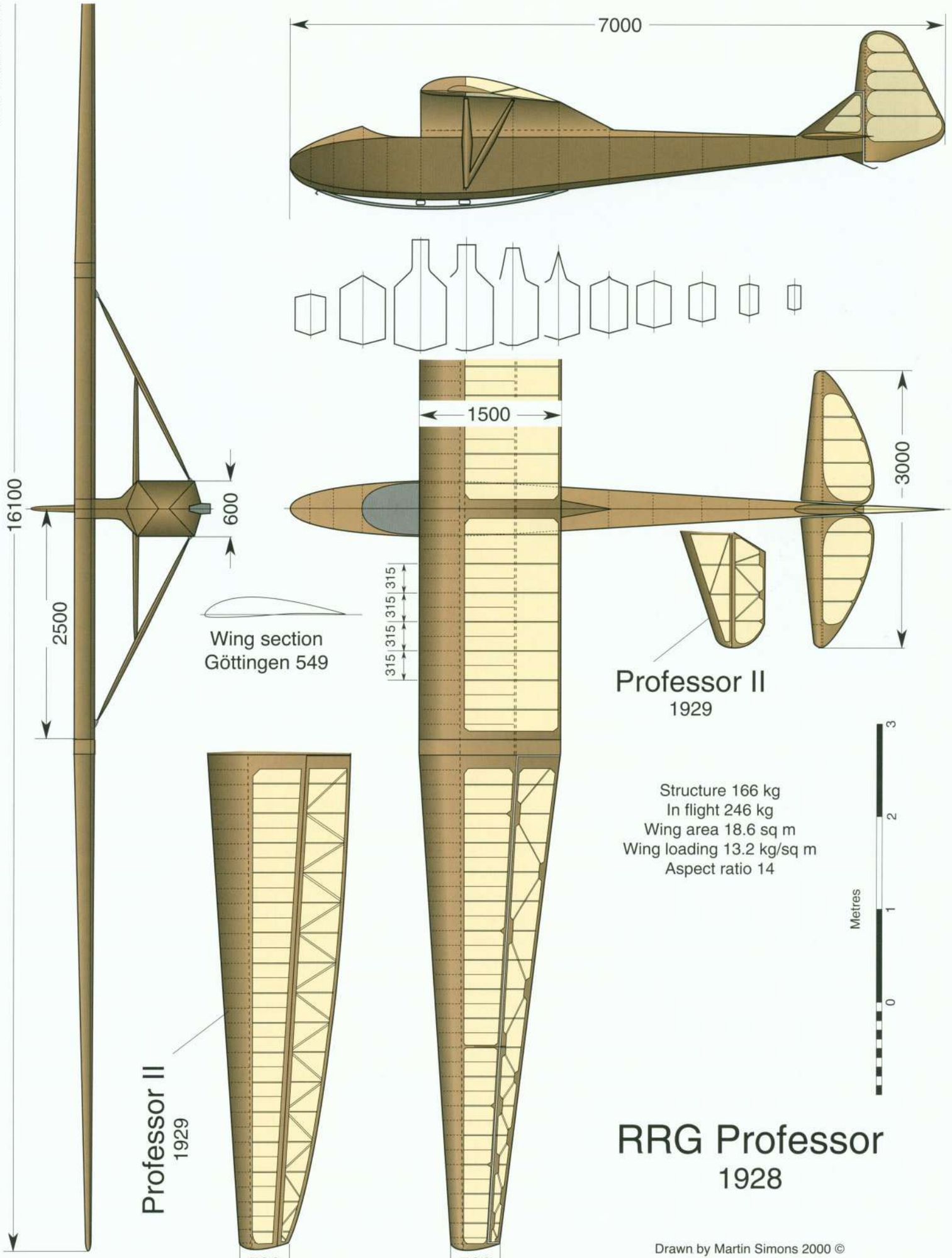
Another important development was the introduction into sailplane cockpits of the variometer, that is, a very sensitive rate of climb and descent indicator. The origins of the device went back to nineteenth century ballooning. Lippisch had used one when working with Dornier on Zeppelins. It had not been realised till now that soaring pilots needed such a thing. So long as they were flying near slopes, they could judge their gains and losses of altitude by observing the ground, how far above or below the hill crests they were, whether the trees were getting closer or further away, and so on. But from any considerable height, especially over flat land, small gains or losses of altitude are undetectable by eye. Pilots far away from any slope might feel bumps, but could not know what they signified, up or down currents, or merely random turbulence. Standard altimeters were far too sluggish to be useful for detecting small air movements. If sailfliers were to rise under clouds and even into them like Kegel, they needed a reliable reference which would continue to work when they were far away from the ground, or out of sight of it.

A pilot was needed who could take advantage of the new ideas and the new instrument. It could have been 'Bubi' Nehring but he seems to have been reluctant to abandon the slopes, despite being the person Georgii had employed to explore lift under clouds. His loyalties may have been divided. He was a Darmstadt Akaflieg man, not dedicated to the RRG. He was soon to take up a permanent position as a meteorological flier in Berlin.

In his stead, the most recent promising pupil from the Wasserkuppe, Robert Kronfeld, an Austrian, was given the opportunity. His great talent as a pilot was already apparent and he started working for Georgii at Darmstadt in May 1928.

Professor

Meanwhile Alexander Lippisch had designed a new sailplane for the RRG, the Professor. It was intended for pilots who had trained on the 'secondary' Falke. It must be capable of soaring flights, but cheaper to build than the Darmstadt types that had dominated the last few years. The RRG hoped it would be produced in large numbers. Nearly all previous high performance sailplanes had been 'one



RRG Professor
1928

Drawn by Martin Simons 2000 ©

Many gliding clubs in Germany used the Professor type. The photo shows the original Rhöngeist fitted with the madified ailerons of the Professor 2. But the tail is still unchanged.

off' designs. Plans of the Professor would be made available for clubs and others to build it under licence.

The wing, in three pieces, rectangular centre section and strongly tapered outer panels, was mounted on a high pylon with V struts. It was the single spar type, with plywood-skinned forward torsion box and light ribs behind with fabric covering. The wing profile was a relatively new one, Göttingen 549, thinner and less cambered than the now well known Gö 535. The prototype was flown on the Wasserkuppe in mid May 1928, and christened after Lippisch, Rhöngeist..

No doubt both Georgii and Lippisch were very anxious that the new sailplane, competing in the 'intermediate' class, should do well. The existence and use of the variometer was not made known to the other pilots. The secret was well kept by all those concerned. Kronfeld had a vacuum flask in a box with him when getting into the cockpit. He said it was his coffee. In fact this was the essential insulated air bottle which was connected with tubing to the dial of a sensitive flow meter. As the sailplane rose and the external atmospheric pressure fell, air would flow out of the bottle through the instrument to record a rate of climb. On descent the reverse happened, air flowed in, showing descent. It was not for another two years that anyone outside the very small circle around Georgii, Lippisch and the elite pilots they worked with, knew of the existence of the variometer and understood what it was for.

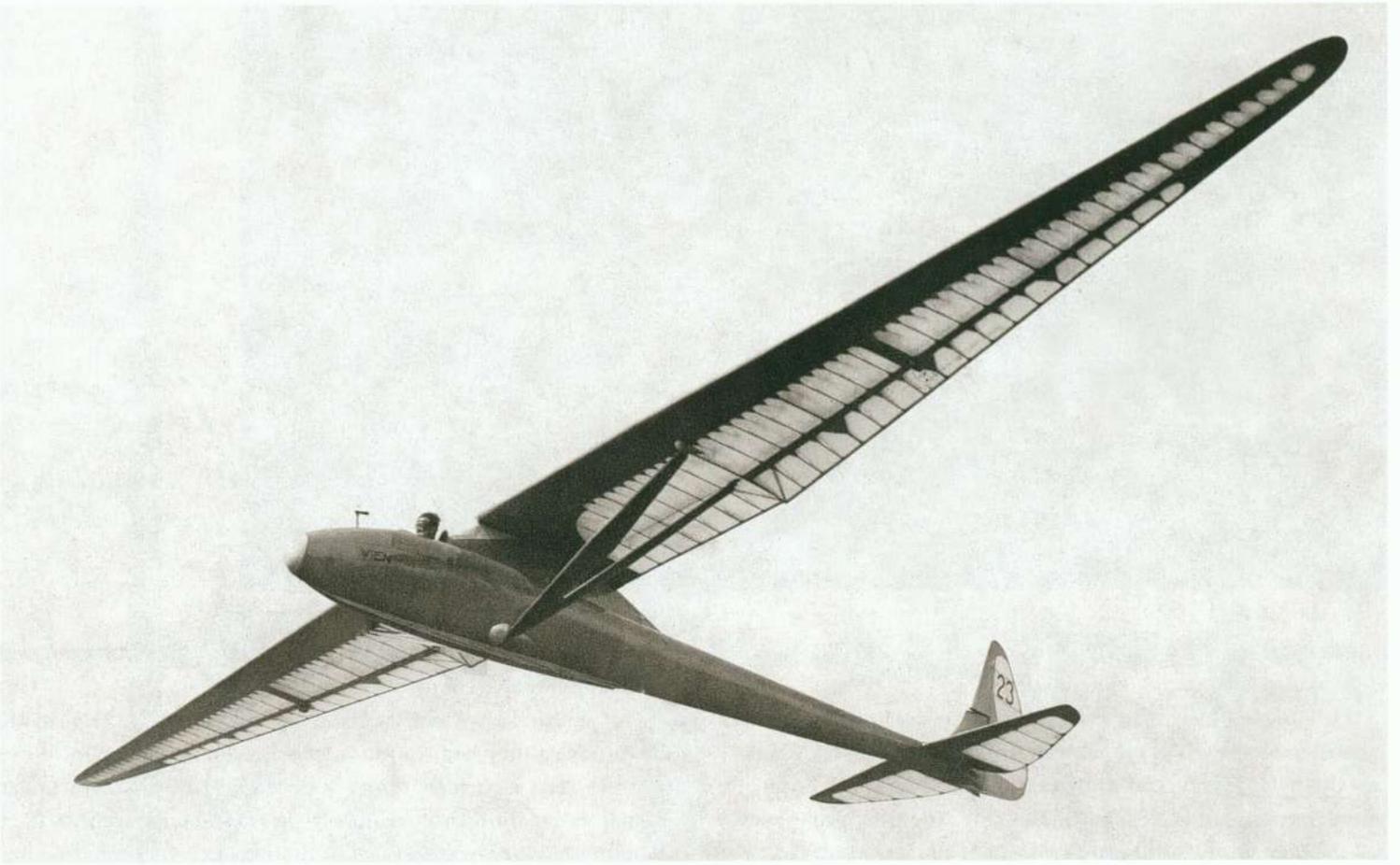
On 6th August 1928, the Rhöngeist joined the competing sailplanes over the slope. When the variometer indicated the additional lift beneath a useful looking cloud, Kronfeld began to circle gently. The Professor climbed away, leaving the other pilots far below, and drifted back. When high enough Kronfeld left the cloud and headed for the Himmeldunkberg, the peak which had been his 'target' for the day. He spent some time there slope soaring. When a cloud approached, he gained height beneath it and set out to fly back to the Wasserkuppe. On the return journey against the wind he passed through more lift below a series of clouds and arrived back with hundreds of metres to spare.

The significance of what he had done was recognised immediately. Although they had no variometers, several other pilots in the next few days discovered they could gain height by circling under clouds. Edgar Dittmar broke the official world height record with a climb to 775 metres and glided from there for 33.5 km to his chosen goal at Bad Kissingen. Wolf Hirth too used lift below clouds to fly across country. By the end of the meeting there were no pilots who did not know of this new development, but very few who understood how it had been done.

Wolf Hirth was the first pilot, after Kronfeld, to grasp the significance of the variometer. He fitted one in his Musterle and took it to the American competitions. It seems extraordinary that no one there asked what the strange dial, with its bottle and tubing, was for. The fact is, variometers were not widely used outside Germany for another two or three years.

Sets of plans for the Professor were taken up by clubs and some professional manufacturers. Segelflugzeugbau Kassel, now owned by Gerhard Fieseler, advertised the type for sale. One went to England where Philip Wills used it for his first cross country flights. In the USA, Gus Haller built two of the type, marketing them as the Haller Hawk. Copies, sometimes with minor changes, were built in several other countries, how many altogether is not recorded.

Despite Kronfeld's success with it, the Professor was not easy for inexperienced pilots. It was very sluggish when straightening out from turns. The strong taper of the wing also made it prone to tip stalling. There were some spinning accidents. These problems were not unique. Many sailplanes of the time suffered from limitations of this kind. Lippisch redesigned the ailerons, broadening the chord by curving the trailing edge. The all moving elevator was replaced by a tailplane with elevator, with consequent detailed alterations to the fuselage. The Professor 2 appeared in 1929.



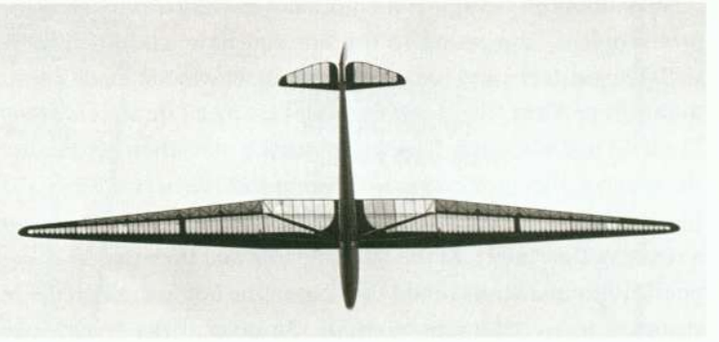
The most succesful sailplane of its time, the Wien, flown by Robert Kronfeld with consistent brilliance.

Wien

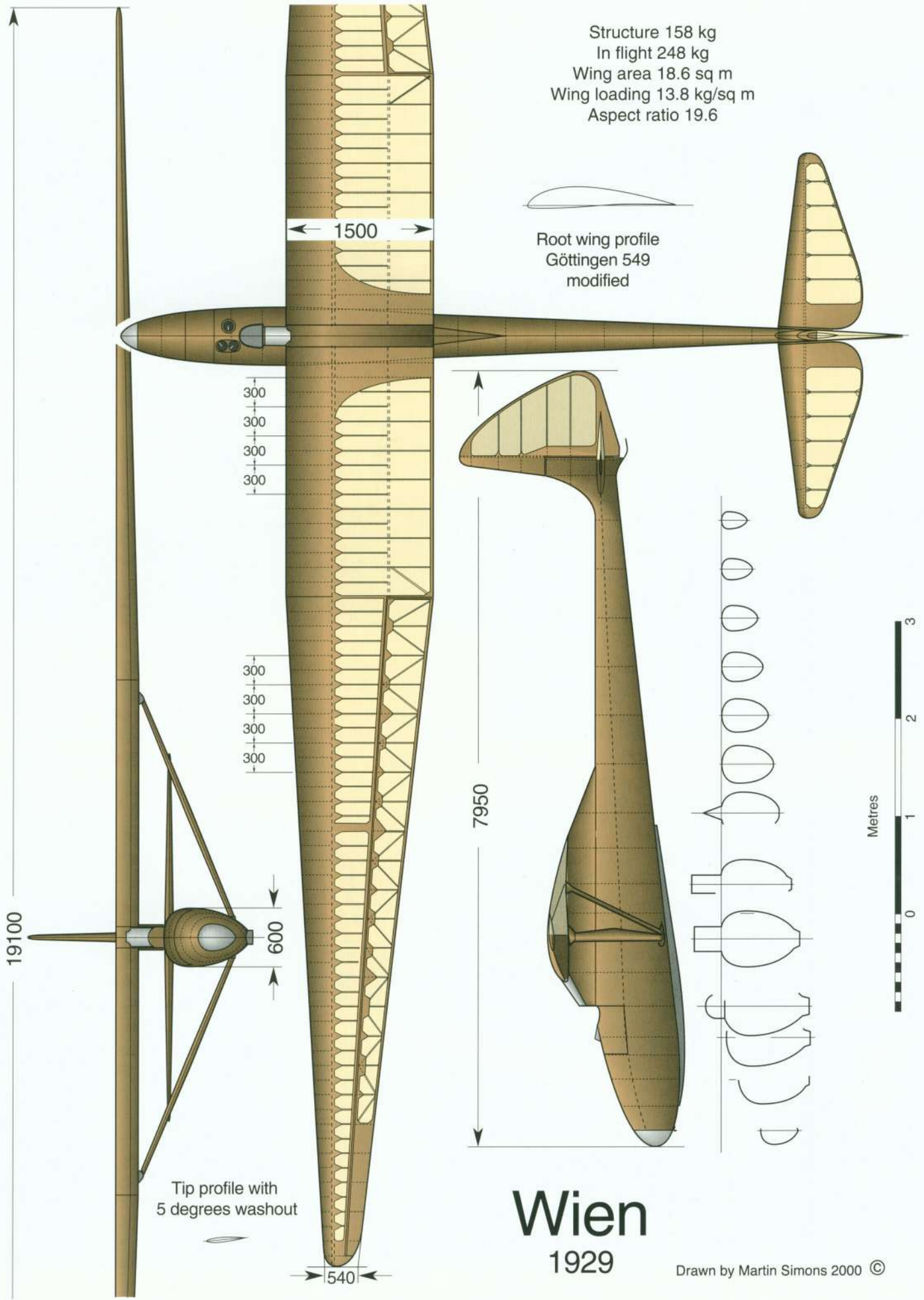
Kronfeld was not content and asked Lippisch to design for him a new sailplane which would be capable of competing with the best available from the Akafliegs. When it was ready he named it after his home city, Wien. Built by Fieseler it was a development and refinement of the Professor, with a much better performance and superior handling. The main features were the same, pylon mounted, strut braced wing with strongly tapered tips, all moving tail plane, Göttingen 549 wing profile with slightly increased camber.

It was well known now that a good glide ratio and low minimum rate of sink required a very high aspect ratio, implying a large wing span relative to the total wing area. In fundamental terms, the sailplane wing supports the aircraft by deflecting or turning a mass of air downwards. For a given weight and airspeed, either a small volume of air may be turned through a large angle, or a larger mass turned through a smaller deflection. The latter is much more efficient. The larger the span, the greater the mass of air coming under the influence of the wing in each unit of time. The span of the Wien was more than 19 metres, exceeding that of the Darmstadt 2.

The fuselage was a fine streamlined shape, the cockpit canopy designed so that only the pilot's head protruded into the airflow ahead of the pylon. The instruments, including a variometer, were mounted face up on the external decking, as was becoming the fashion.



This was a beautiful and impressive sailplane which Kronfeld used to very great effect. He made the first ever 100 kilometre flight, following the slopes along the Teutoburger Wald ridge, but using thermals to bridge gaps whenever necessary. Thermal soaring then became the norm for him. The Wien broke the world distance record time and again, achieving 164 kilometres in 1930, and height records of 2025 and 2560 metres in July 1929. On some occasions Kronfeld climbed into huge clouds, without any blind flying instruments, and emerged out of their tops to fly above them. At the invitation of the newly formed British Gliding Association he toured England with the Wien, giving demonstrations. On one of his flights Kronfeld flew from Hanworth, near Richmond, to



Wien

1929

Above: Bungge launch of the Wien at the Wasserkuppe.

Below: Rigging the Wien before its demonstration flights in Yorkshire.

Left: The Wien instruments mounted on the fuselage decking. A replica by Klaus Heyn

Right: Groenhoff prepares to fly the Fafnir.

Chatham on the Thames Estuary, passing over the city of London itself. Next day he soared back again taking a more southerly route via Croydon, a pre-declared goal flight. This would have been a world record except the goal flight category was not yet recognised and launching by aero tow, a method only very recently developed, also prevented Kronfeld's flights from being officially accepted.

Kronfeld also used the Wien to glide twice across the English Channel. This won him a prize from the Daily Mail newspaper, but was not a soaring flight. He was towed by a Klemm monoplane up to about 3000 metres and glided across from there, and the same on the return journey, late in the evening of the same day.

For Walter Georgii, the most significant flight Kronfeld made in the Wien, a distance of 164 km, was probably at the end of August in 1931. The distance did not break any previous record but afterwards Georgii wrote „this flight offered the first important scientific information about the frequency of convection currents. They are apparently so plentiful that if the weather is favourable and the sailplane has enough altitude, a short gliding flight leads again to an effective up current zone." Thus the whole future of soaring as a cross country sport was opened up.

News of the great thermal flights in Germany spread quickly. In other countries, the soaring movement began to develop rapidly. Naturally, when designers learned of Kronfeld's successes, they were influenced by the sailplane he had used for most of his great flights and demonstrations, the Wien.

Fafnir

Lippisch in 1929 began the design of a new high performance sailplane, which was called the Fafnir after the legendary dragon. The RRG had a new test pilot. Günther Groenhoff had learned to fly under Ferdinand Schulz on the dunes at Rossitten. His great abilities became apparent and he joined the RRG school on the Wasserkuppe as an instructor in July 1929. He was made aware of the variometer but kept the secret even from Peter Riedel, with whom he worked on the development of aero towed launching. Riedel now was a trained power pilot but had not, as yet, done much gliding himself since his youthful endeavours in 1920 and 22.

The cross sectional area of the Fafnir fuselage was as small as it could reasonably be, designed around Groenhoff. Not a large man, he only just fitted. The cockpit canopy, of wood, fitted closely round his head and he had only two portholes to look through, lacking even the small transparent windows of Hirth's Musterle.

The wing had no supporting struts, to save drag. The cantilever main spar, accordingly, had to be very strong, requiring a thick wing at the root to allow depth for this member. It spanned 19 metres, tapering to very narrow tips and with a slightly arched or 'gull' form when seen from the front. Reasons for the shape have been variously given. Wenk's tailless aircraft remained in the mind. Lippisch's Falke and the Storch VIII Marabu had a very slight 'gull' bend, visible in the front elevation. Most earlier sailplanes had no dihedral but it was now recognised that some was useful in circling flight. Perhaps influenced by sea birds, it was thought that the cranked form must be particularly good. Also the Fafnir had no central pylon like the Wien to carry the wing high off the ground. To slant the inner wing up gave the tips extra clearance. Such a bend in the spar, which had to be laminated to form the curve, made construction more difficult but it was thought worthwhile. The Fafnir was, for many years, considered to be the most beautiful of

Considered to be the most beautiful sailplane of its time, the Fafnir, flown by Groenhoff, at the Wasserkuppe.

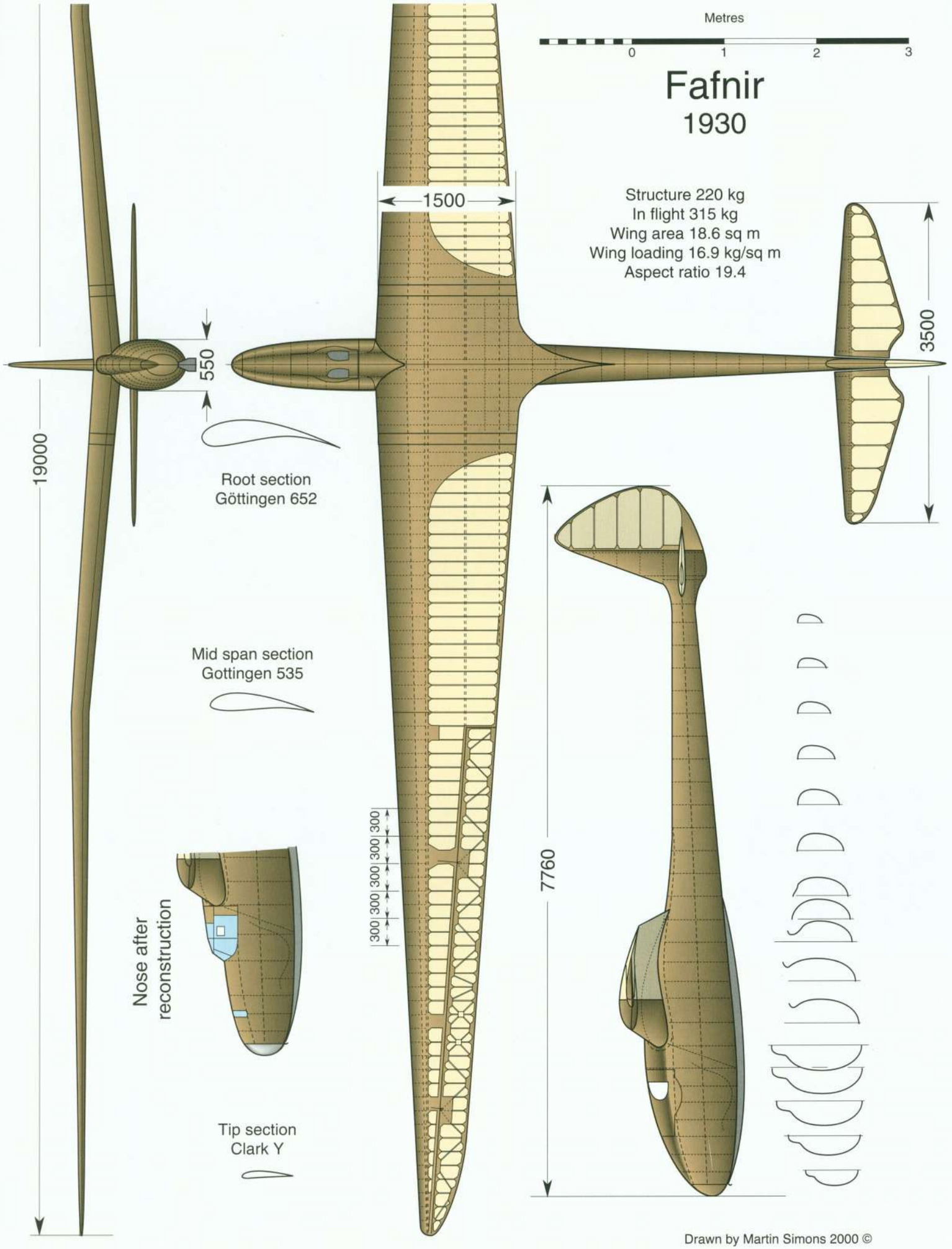
all sailplanes and set a fashion for 'gull wings', without any real evidence in support of the trend.

The wing root was faired to the carefully streamlined fuselage at the level of the pilot's head. Numerous small strips of plywood were scarfed together to make the complicated, three dimensionally curved form. The wing profiles also were complex. The profile chosen for the root was the very thick and strongly cambered Göttingen 652, which Prandtl's wind tunnel had shown as very promising at the low speed, minimum sink trim. This changed progressively to the familiar Gö 535 at the gull bend, and thence to the well proved and well behaved American Clark Y at the tips, with washout to control tip stalling. The ailerons were not tapered, the width at the tips intended to give them greater power. The wing ribs were closer spaced than was usual on earlier sailplanes, Lippisch extending the intermediate ribs to the trailing edge. The tail unit was of the usual all moving type, the elevators mounted about the mid line of the narrow rear fuselage and the rudder horn lower still, in fact close to the ground when the sailplane was at rest.

The Fafnir turned out heavier than expected but this was found to be no serious disadvantage. It was only just ready for test flying on the first day of the 1930 Rhön meeting. Groenhoff was disappointed. The performance was not as good as expected. He could, probably, hear that the airflow was very turbulent over the centre of the wing just behind his head. With blocks of balsawood glued on and hastily carved to a less complex shape, the fairing was modified. The result was satisfactory and the performance now clearly very good. Following the competitions, Groenhoff, after an aero towed launch, became the first pilot to exceed 200 km in soaring with a 278 km cross country flight from Munich. Because aero towing was still not officially accepted for records, it was only when he made 220 km from a bungee launch that the official distance record was deemed broken.

The Fafnir joined an expedition to the High Alps of Switzerland in 1931. Here a design fault was revealed which nearly cost Groenhoff his life.

Launching by bungee from the snow fields on the Jungfrau was difficult. The crew, slithering and sliding, could barely stretch the rubber rope sufficiently and at high altitude the speed required for take off was greater than low down because of the reduced air density. The Fafnir slid forward, not having gained flying speed. The starboard elevator struck a snow mound and was broken off. The sailplane careered down slope, eventually pitching over the edge of a cliff. Fortunately now it had enough speed to fly. Without half his elevator, Groenhoff managed to keep control and landed without further damage in the valley. A new elevator was hurriedly made in the RRG workshops in Germany and rushed to the Jungfrau. After two more flights there was further damage, this time to the rudder. The low mounted rudder horn was proving vul-



Drawn by Martin Simons 2000 ©

Above: To save a little drag, the pilot was fully enclosed with only small portholes to see through. Behind the Fafnir among the crowd is Peter Riedel. with arms akimbo, dark jacket and tie.

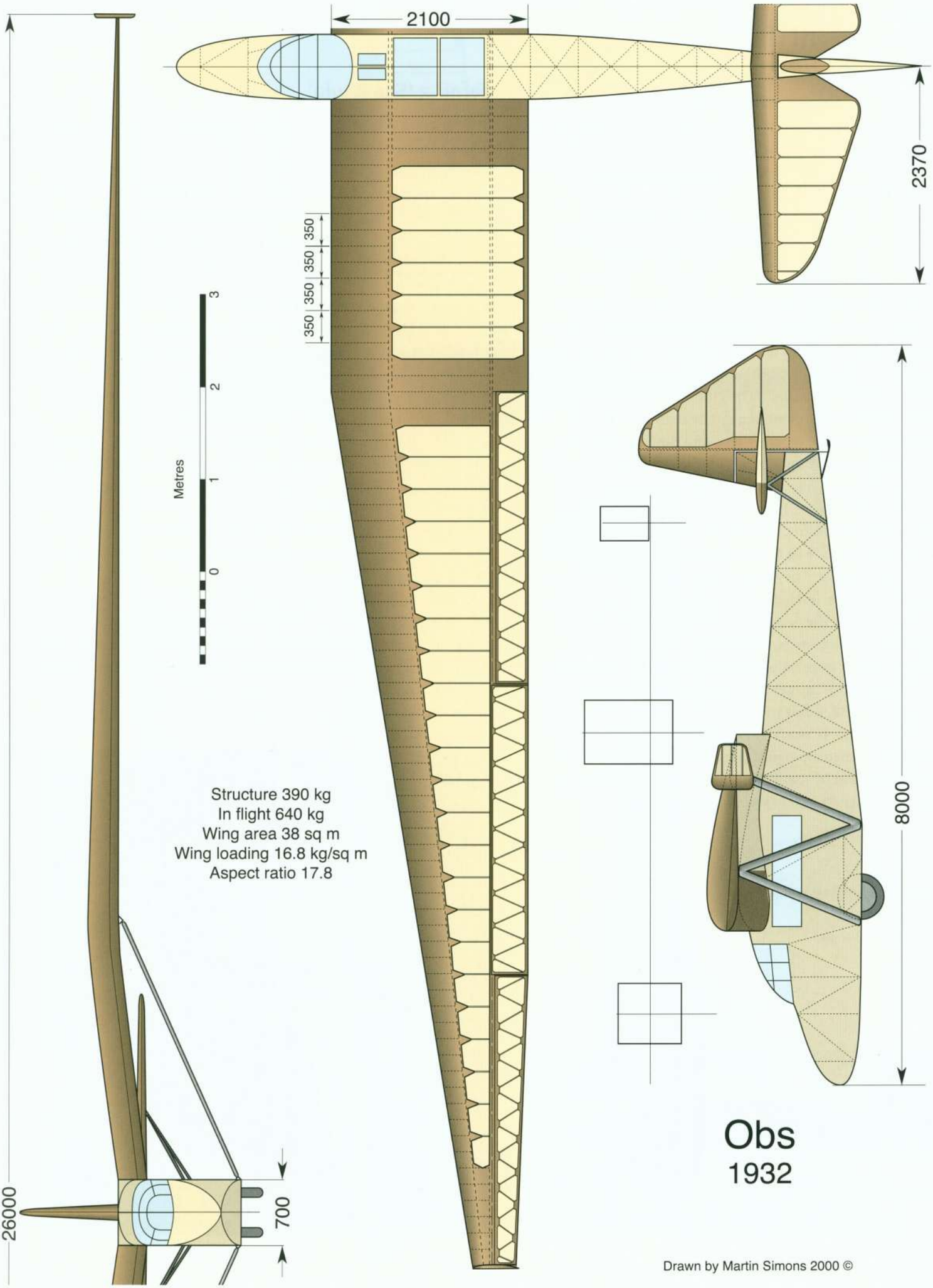
Left: Ready for take off, Riedel in the Fafnir on El Palomar airfield, the Moazagotl behind.

nerable. The rudder hinge and sternpost had to be repaired before launching again.

After these mishaps, 1931 was the Fafnir's year. At the end of the Rhön meeting, the usual order was reversed, Groenhoff first, followed by Hirth and Kronfeld. He became something of a hero especially when he made outstanding flights in Lippisch's experimental tailless powered aircraft.

All ended tragically on March 1932 when Beate, Peter Riedel's sister, was killed in an open car being driven by Groenhoff. His carelessness was the cause. Afterwards he suffered from serious depression, even attempting suicide. At the Rhön in July, he was to fly the Fafnir. Once again, in a bungee launch the tail was damaged. The sailplane took off, the rudder horn hit something on the ground and the whole rudder broke loose, jamming the elevator. Groenhoff succeeded in bailing out but the parachute did not open in time. He fell among the trees down the slope and was killed.

The Fafnir was very seriously damaged but was rebuilt with a larger cockpit and an enclosed, transparent canopy. Now it was Peter Riedel's turn to fly it, for his star was rising and he had discovered the variometer. He flew the Fafnir in June 1933 from Darmstadt into France, 228 kilometres, and took part in a publicity stunt, soaring over Berlin from aero towed launches. The following year



Structure 390 kg
In flight 640 kg
Wing area 38 sq m
Wing loading 16.8 kg/sq m
Aspect ratio 17.8

Obs
1932

when Georgii led an expedition to Latin America, Riedel and the Fafnir were in the party. He accomplished some good distance flights and on one day soared over Buenos Aires for seven hours. After this, the Fafnir remained in use at Darmstadt. It was finally retired and placed in a Berlin museum in 1938, but did not survive the wartime bombing.

Obs

The Urubu Obs, to give it its full name, was designed by Lippisch during 1931 - 2 at the request of Professor Georgii, head of the RRG meteorological division, as a research vehicle. (The Urubu is an Argentinian vulture.) The cabin behind the pilot was large enough for two passengers but it normally carried only one, a scientific observer, with a large array of instruments. The strut-braced wing, with slight sweepback on the outer panels, gull dihedral and small tip winglets, was reminiscent of the tailless Storch series, but the Obs had normal tail surfaces. The inner section of the very long ailerons, were also camber flaps. It is not known if these were intended as brakes for landing. The Obs is reported to have had spoilers on the upper surface of the wing but these are not shown on any published drawing. They may have been fitted as a retrospective modification. The fuselage was built up in welded steel tubing, wide enough to carry the necessary equipment, and covered in fabric. There was a two wheeled undercarriage.

Launching such a large sailplane was difficult and it proved necessary to use powerful tug aeroplanes. After one appearance at the Wasserkuppe in 1932, it was stationed at Darmstadt and used in research, as intended. It made an appearance at Munich in 1934 when there was a meteorological conference. It is said that, on this occasion, it was seen by Adolf Hitler and it may be that the idea of using gliders to carry troops in war, was born then.

Right: The Fafnir 2 in 1934 at the fifteenth Rhön

Below: The Urubu Obs in 1932

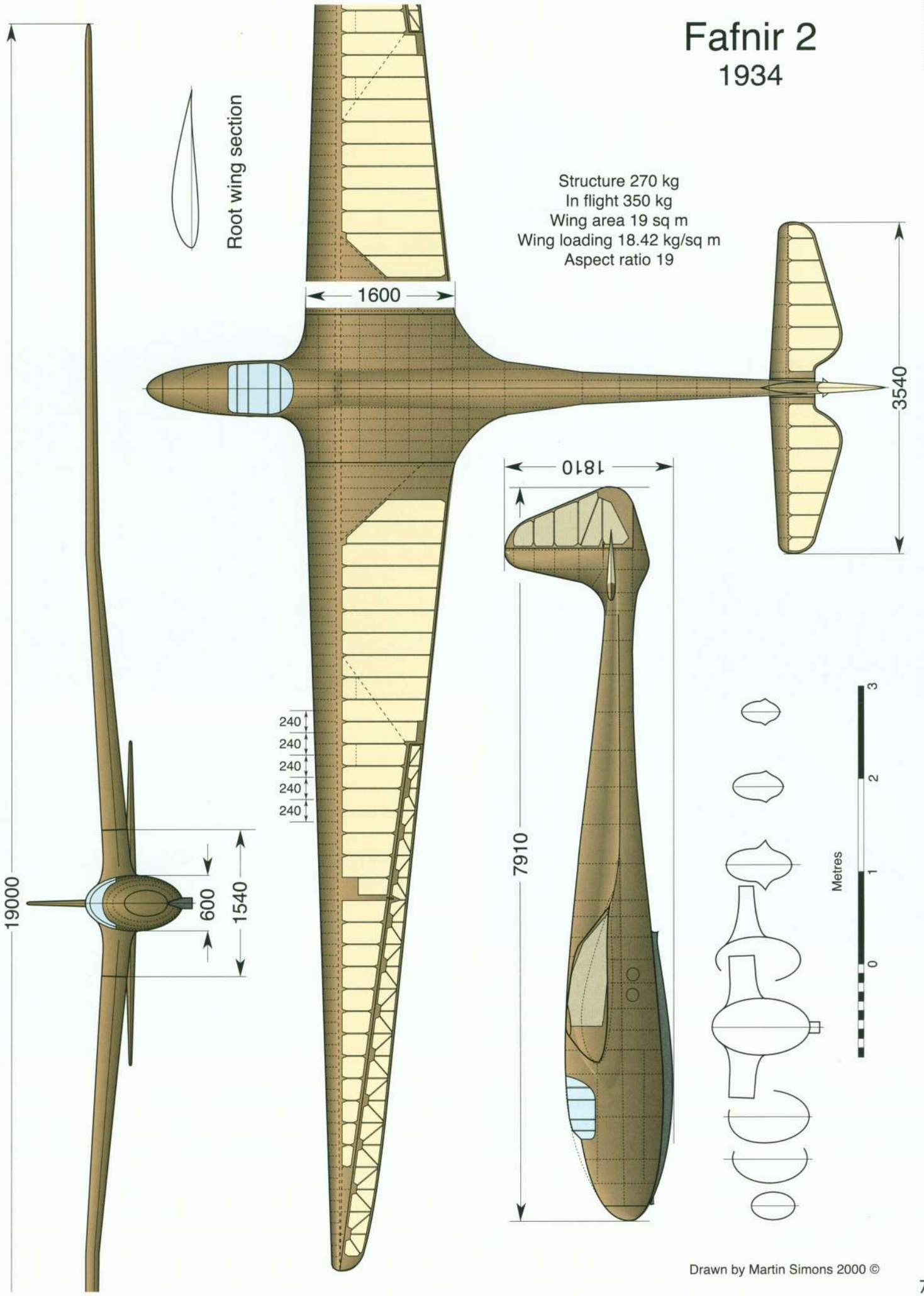
Fafnir 2 'Sao Paulo'

The junction of a wing with a fuselage always creates some extra drag and distorts the distribution of lift across the span. One common approach to this problem has been to suspend the fuselage below the wing on struts or a narrow neck, in the hope that the flow over the lifting surface will be undisturbed. Another attempted solution is to mount the wing in a mid position and add fairings to fill awkward corners to prevent flow separations. A compromise chosen by many sailplane designers has been to mount the wing on top of the fuselage, leaving at least the upper surface unobstructed, and then doing what can be done with fairings to fill in and smooth the flow underneath the wing root. To mount the wing below the fuselage has rarely been favoured because, even with elaborate fairings the lift is seriously reduced and the underside of the wing is vulnerable to damage when landing or taking off.

Wind tunnel research at Göttingen University by H. Muttray showed that the mid wing position was measurably better than the parasol, high, shoulder or low positions, but also suggested that the fuselage should be shaped to conform as far as possible to the flow pattern over the lifting wing. The fuselage should not be treated as a parasitic item with fairings to minimise the harm, but should blend with the wing and give some useful lift.

Lippisch applied this to the Fafnir 2, which was named Sao Paulo in honour of the Brazilian city which offered some financial support. The fuselage in side view was cambered like a wing profile, the form blending gradually into the wing. To create such a shape using timber required elaborate framing and a skin built up of numerous small pieces of plywood scarfed together piece by piece. Lift distrib-

Fafnir 2
1934



Drawn by Martin Simons 2000 ©

ution calculations were carried right through the fuselage. The main wing section was a special design by Lippisch, much less cambered and thinner than he had used on the Fafnir 1, because it was understood now that a cross country sailplane needed to fly fast when not actually climbing in a thermal.

Design began in March 1934 and the Sao Paulo was completed in time for the 1934 Rhön. It was the best sailplane available at the time. With it Heini Dittmar broke the world distance record, 375 km, landing in Czechoslovakia. The original cockpit canopy did not blend fully into the fuselage. By the time of the international competitions in 1937, which Dittmar in the Fafnir 2 won, a fully contoured canopy had been fitted.

When the performance of the sailplane was measured in flight, it proved to have a best glide ratio of 26:1. Although a good figure for its time, the improvement was relatively small considering the effort required both in design and construction.

After this, Lippisch turned again to the development of tailless aircraft, eventually leaving the DFS altogether for a post in the aircraft industry. His work for Messerschmitt in Augsburg culminated in the rocket powered Me 163 fighter.

Above: The cockpit canopy originally (1934) was not fully faired to the fuselage.

Below: By 1937, for the International Championship, the Fafnir 2 had been painted and the canopy fully contoured. A 'drop off' wheeled dolly was used for launches.

Chapter 6 Dittmar and the Condors

Condor

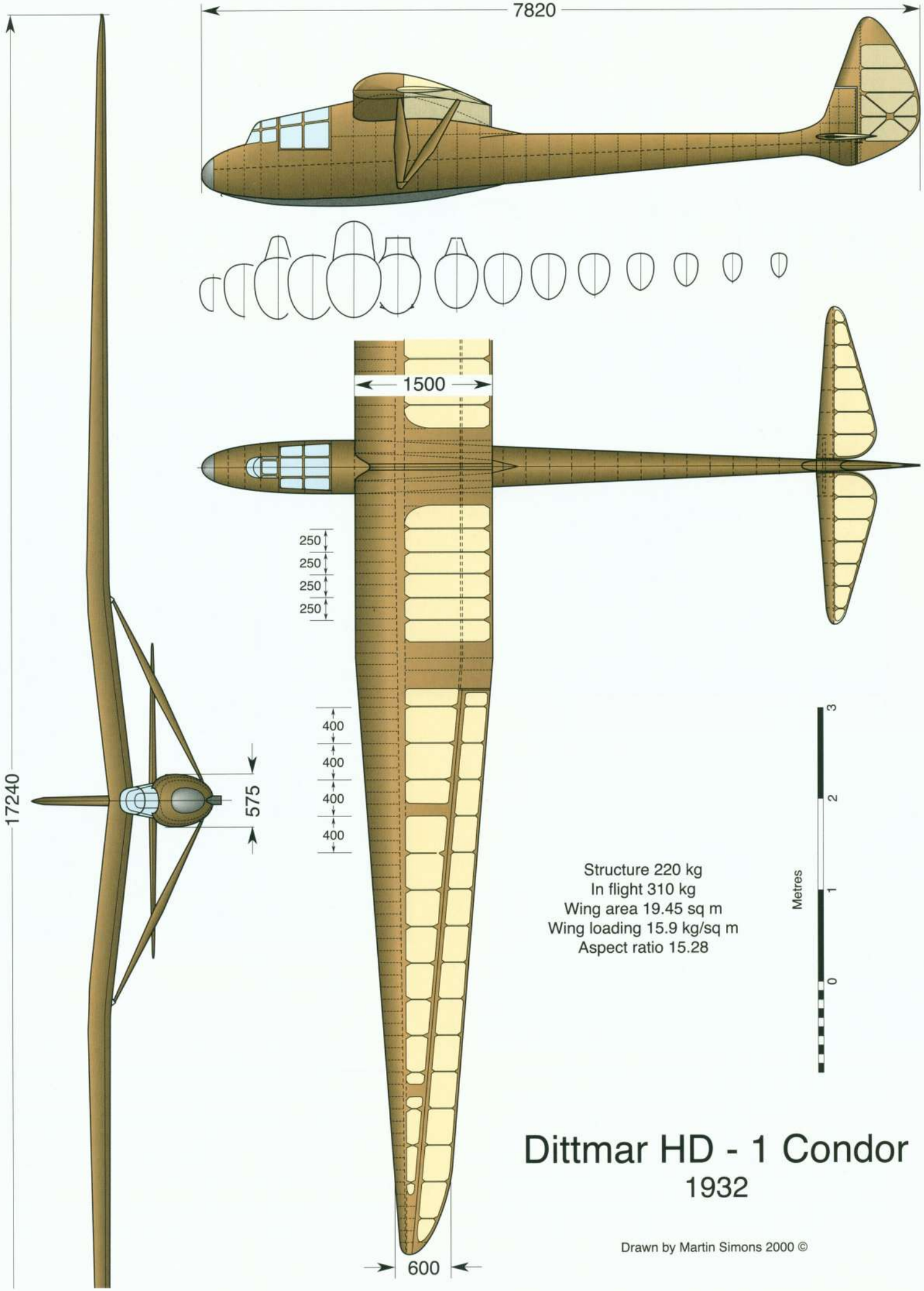
Edgar Dittmar, who had broken the height record in 1928, had a younger brother, Heinrich or 'Heini'. While still a schoolboy he learned to fly gliders, paying his costs by working for Lippisch in his spare time, building models of tailless aircraft for testing. While launching one of these in 1932 he injured his knee by stepping into a hole. While recovering in hospital he began to design his own sailplane, the Condor. In it he tried to copy the best features of the Wien and Fafnir, with improvements. Fritz Kramer, a qualified RRG stress man, checked the strength of the structure for him.

The fuselage and tail unit were taken almost directly from the Fafnir, using, wherever possible, the same frames and components. Jigs and tooling for them were available in the RRG workshops. One important alteration which Dittmar made at the tail arose because of the accidents to Groenhoff. The rudder horn was moved up well clear of the ground. The operating cables were conducted, through fairleads, out of the fuselage ahead of the tail and externally above the elevator. Heini's other alterations were in the forward areas. Airflow problems at the wing junction with the fuselage had affected the Fafnir. The very thick, strongly cambered wing profile was replaced by a modified form of the Gö 652, still very thick but less strongly cambered. Like the Wien, the Condor wing was raised on a narrow central pylon, where flow interference would be less, and braced with V struts. The Fafnir had been somewhat heavy. The struts saved weight, but the arched 'gull' form was retained. The cockpit was enlarged and fully enclosed, except for the usual small viewing panels and portholes. The pilot, as with the Fafnir, still had barely room to turn his head.

In plan, the wings resembled those of the Wien but had a more modest span of 17.24 metres. Dittmar had understood the necessity for the outer, tapered panels, to be built with washout and change of section to prevent tip stalling and spinning. The ailerons increased very slightly in chord toward the tips, which experience with the Fafnir indicated was preferable to tapering them like the Wien.

Heini built the Condor in the RRG workshops, taking 2000 hours of his spare time. The new aircraft was test flown by his brother with good results in July 1932. It proved easy and safe to fly, handling well with a good performance, especially at low speeds when circling. Heini immediately began to make his mark as a pilot, winning the junior division of his first competition. For him this was the beginning of an outstanding career in soaring. He and the Condor were included in Georgii's 1934 expedition to Latin America where, flying in cloud, he reached 4350 metres above his release from aero tow. He had no oxygen but had had a very brief blind flying course at home. This sensational result, 1790 metres more than the previous figure by Kronfeld, made his name and that of his sailplane. He and the Condor joined a successful Alpine expedition in 1935.

The Condor flying over Berlin



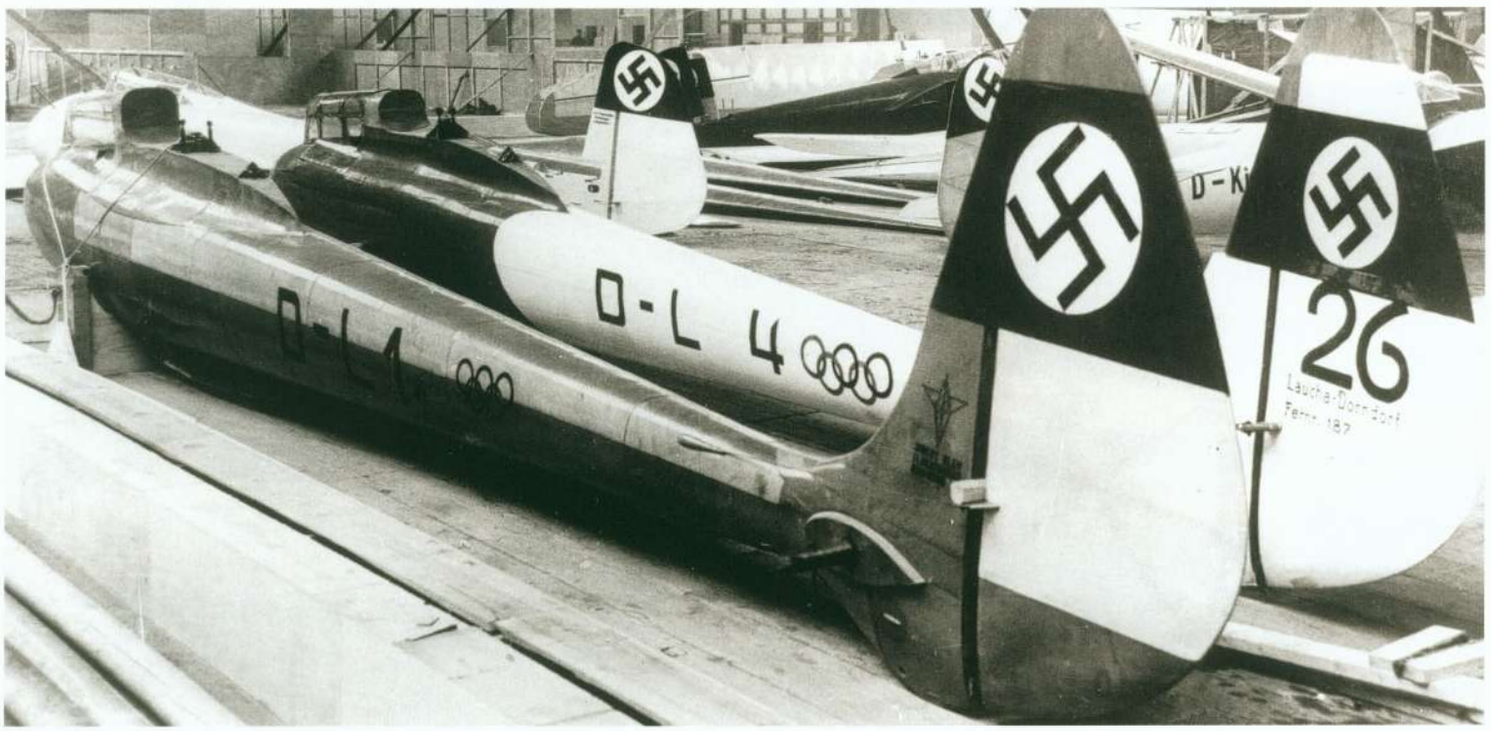
Dittmar HD - 1 Condor
1932

Meanwhile the Condor was put into serial production by Robert Bley of Naumberg. The wooden cockpit canopy was replaced with a built up, transparent one which was much more practical, but no other important changes were made. It was noticeable, however, that less care was taken with the plywood skin. Rather than scarfing the joints to make them almost invisible, they appear always to have been simply overlapped. There was probably no detectable effect on performance but the appearance suffered.

At the 1934 Rhön ten of the type competed and in 1935 a Condor was one of four sailplanes to achieve a 504 kilometre, world record

Above: The Condor on El Palomar airfield, Buenos Aires.

Below: March, 1936. At an aviation and water sport exhibition in Berlin, Condors carrying the Olympic rings were displayed. Note the high rudder horns and cables passing above the all-moving tailplane.



La Falda was flown as a 'pure' sailplane. The intention was to use the motor to bring it home after an outlanding.

Above: The Condor 2 in England

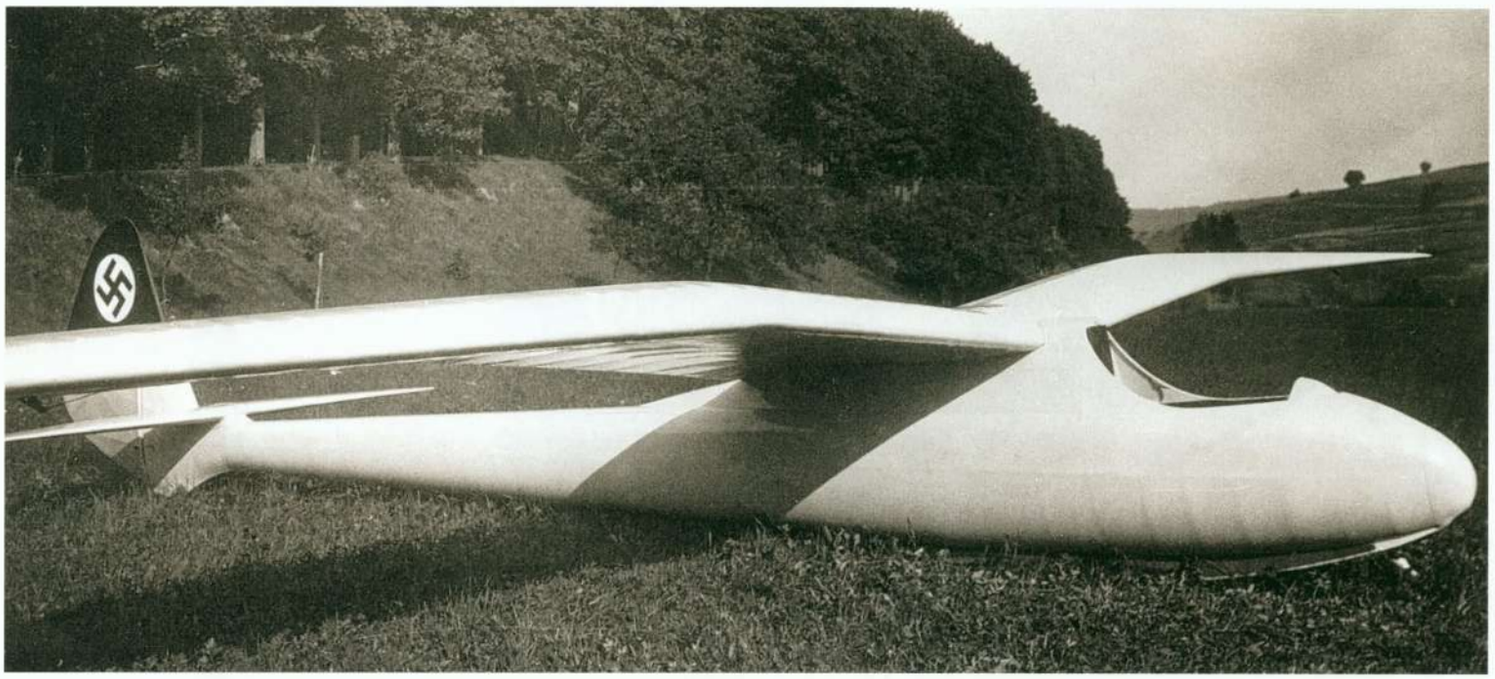
distance flight on the same day. The pilots flew from the Wasserkuppe to Brno in Czechoslovakia. Sadly, on the aero towed journey home, the Condor fuselage failed in flight. The whole front portion, including the cockpit and the seat, broke off when there was a jerk in the towline. The pilot, Rudolf Oeltzchner, was killed when his parachute failed to open. A serious defect in workmanship was established as the cause, which led to the demise of the Bley company.

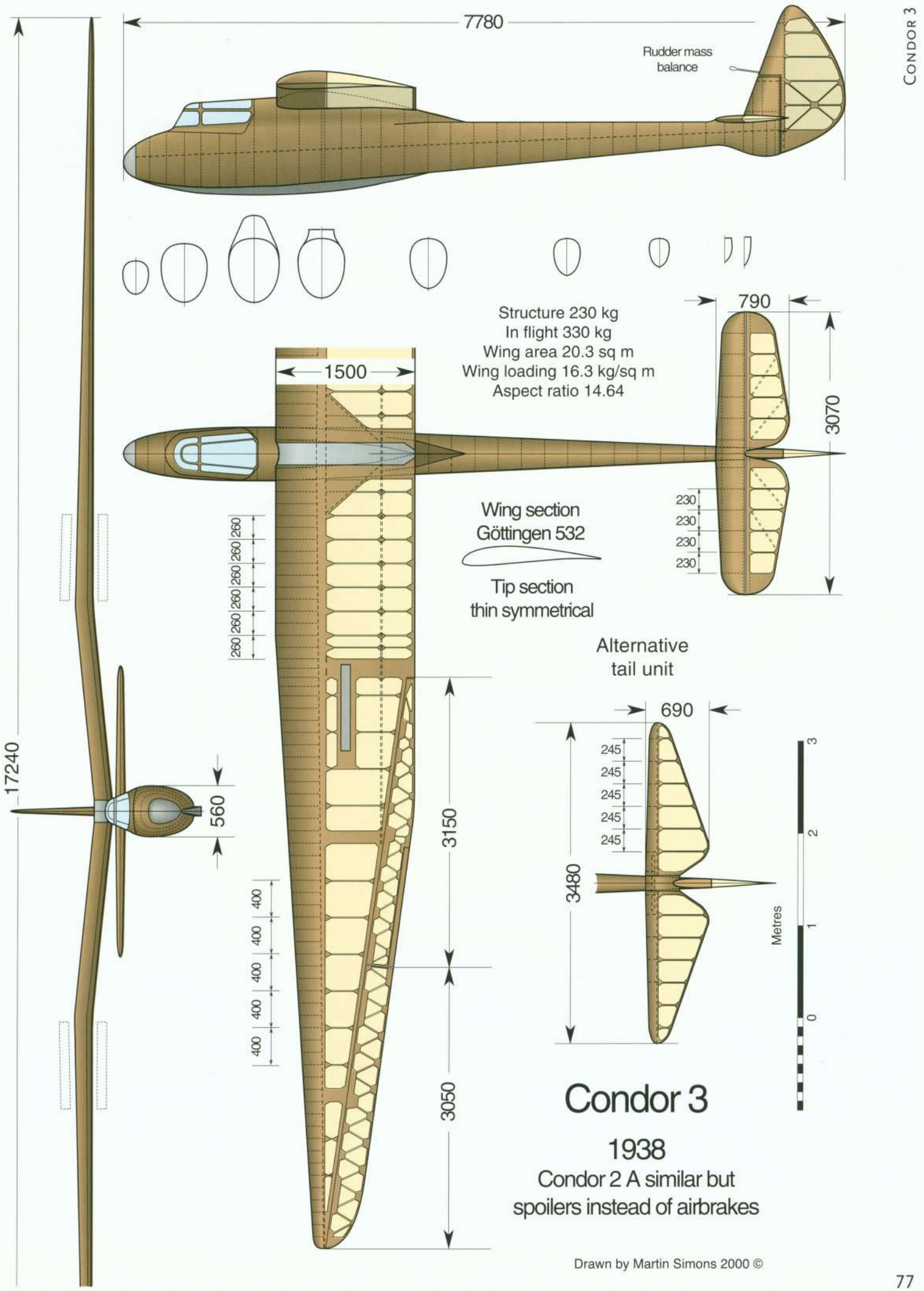
Another Condor of note was Peter Riedel's La Falda. For this he designed a detachable pylon mount to carry an 18PS motor with pusher propeller above the wing centre section. La Falda was capable of taking off and cruising under power. Riedel's idea was to use it as a sailplane but on landing away from home, rather than needing a road trailer or an aeroplane to retrieve it, his crew would bring the motor and pylon, bolt it in place and then he would fly home. In practice it took far too long to get the engine fixed securely and, after many trials, the project was abandoned.

By this time Heini Dittmar was working on a new design, the Condor 2, which had a more modern wing profile, the Göttingen 532, much thinner and less cambered than before, and spoilers. The all-moving elevator was raised to a less vulnerable position. The V struts were retained but before long the Condor 2A was offered with a fully cantilever wing and with a choice of horizontal tail, either all moving or fixed tailplane with elevator, and airbrakes rather than spoilers. Further changes of detail led to the Condor 3, which became a popular contest sailplane just prior to the outbreak of World War 2. The Condor 4 two seater came in post war years.

Left: Edgar Dittmar elder brother of the designer, with a Condor III.

Below: Condor III with cockpit canopy removed.





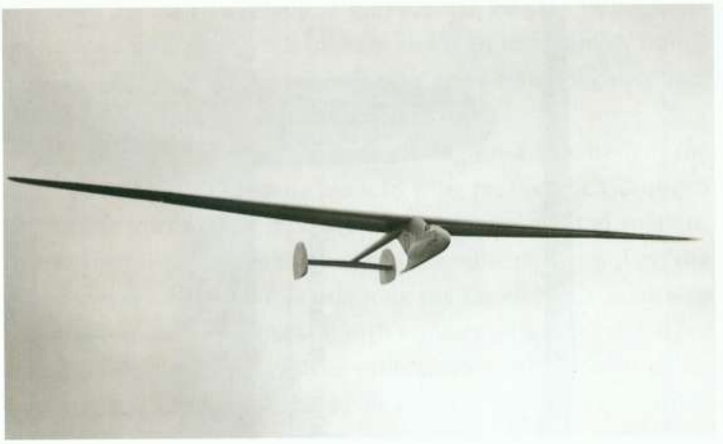
Condor 3

1938

Condor 2 A similar but spoilers instead of airbrakes

Chapter 7 The very large and the very small

Granted, thermal soaring was possible. But what kind of sailplane would be best? The existing high performance sailplanes had developed from hill soarers. Now pilots were venturing into clouds and finding turbulent air hardly dreamed of before. Surely a radical change in flying techniques should be reflected in a new breed of sailplane. Large or small? Fast or slow? Light or heavy? Responsive to delicate handling, or stable and steady?



Above: The mighty Austria in flight.

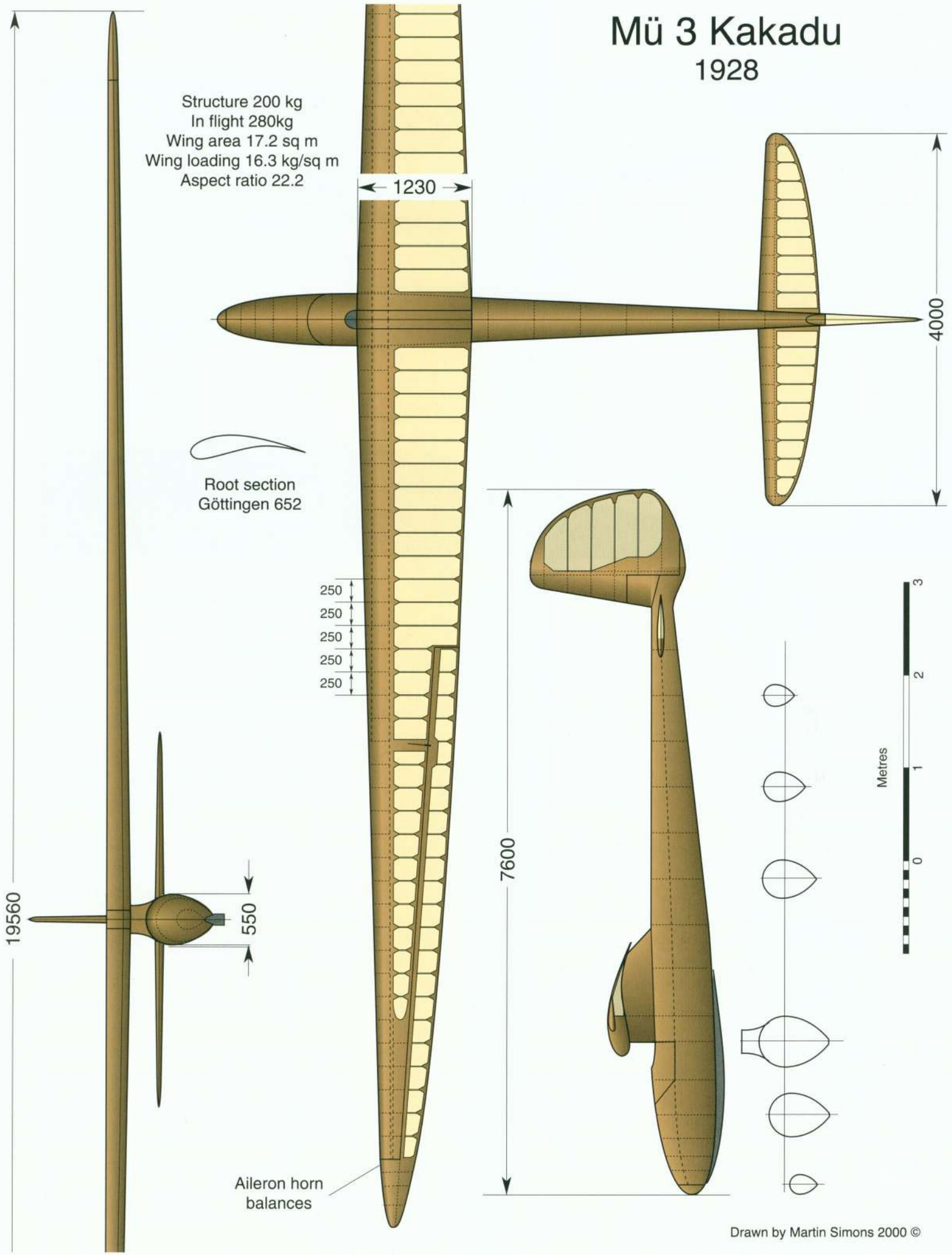
Below: The Austria at Hanworth in England, June 1931.

Austria

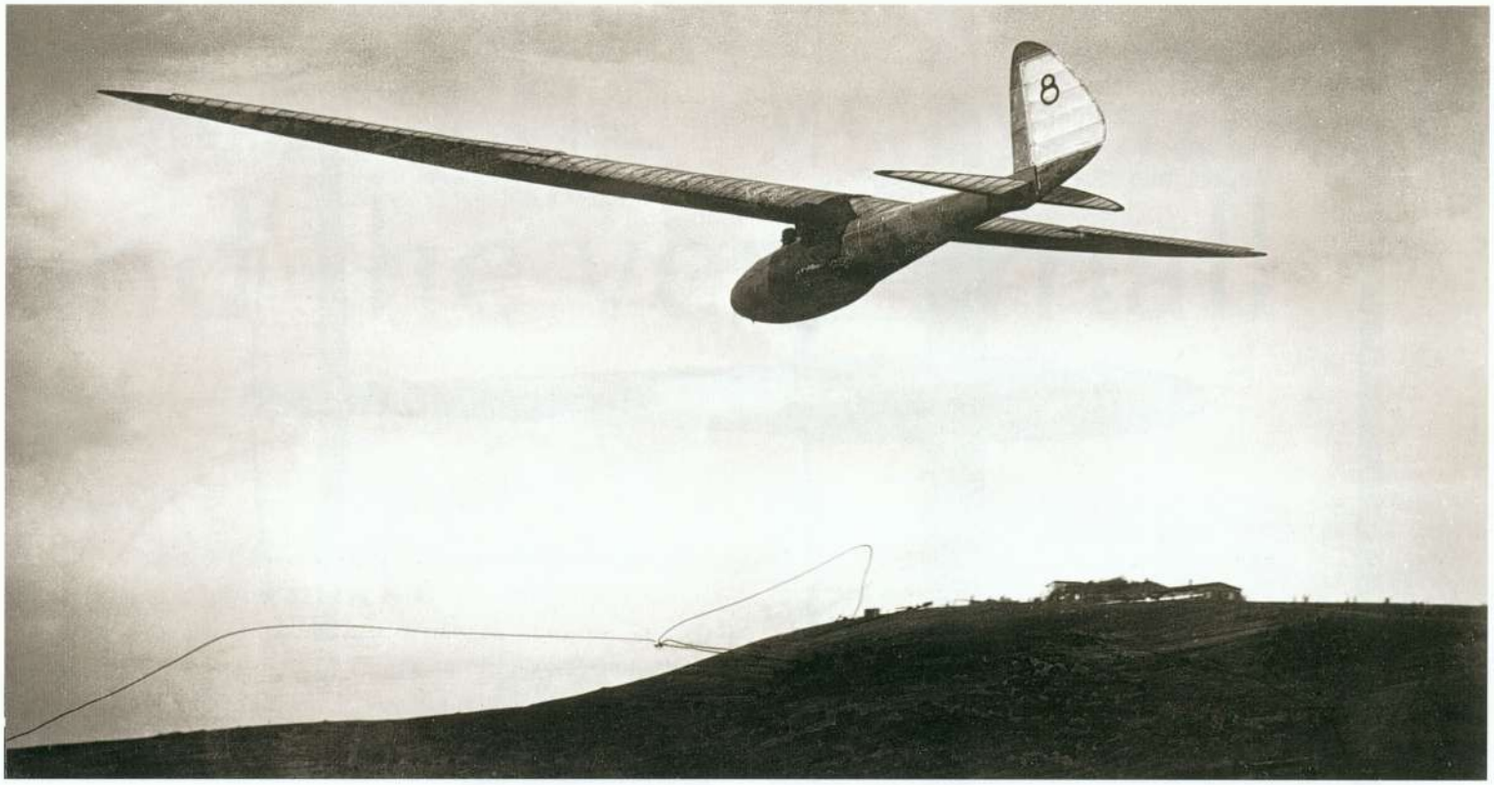
Robert Kronfeld had been much impressed by finding that he could sometimes fly straight for significant periods by following cloud streets. He had done this on the first ever thermal cross country flight and repeated it on other occasions. If he had a sailplane with

Mü 3 Kakadu
1928

Structure 200 kg
In flight 280kg
Wing area 17.2 sq m
Wing loading 16.3 kg/sq m
Aspect ratio 22.2



Drawn by Martin Simons 2000 ©



Küpper's Mü 3 Kakadu launched from the Wasserkuppe.

a sufficiently flat glide angle and a very low sinking speed, it ought to be possible to make long distances with only the occasional need to circle in a thermal. This is now well recognised as 'dolphin soaring' but Kronfeld imagined it long before that term was invented.

Kronfeld approached the Munich Akaflieg, where Dr August Küpper was the leader. Among the notable sailplanes he had designed was the Mü 3 Kakadu , an outstanding sailplane of 1928 with span of 19.56 metres and aspect ratio 22.2.

The outcome of the consultation was the mighty Kü - 4, Austria. The logic of the aerodynamic argument always led to a large span and high aspect ratio. The Austria spanned 30 metres, far greater than any other sailplane at the time. Only in the year 2000 with the flight of the Eta of 30.9 metre span, has the Austria been surpassed in size. The aspect ratio was 25.7. (The figure for Eta is 51)

The Austria cost more than four times as much as the Wien. To achieve sufficient strength and stiffness the huge wing was entirely skinned with plywood, filled, painted grey and polished to reduce skin drag. The Göttingen 652 section, chosen by Lippisch for the inner wing of the Fafnir, was used for the whole span of the Austria. But Küpper realised that such a form would be a handicap for gliding between thermals. He fitted the sailplane with 'flaperons', ailerons which could also be used as flaps to reduce camber in the glides. These principles are fully accepted now although the extraordinary 652 profile is regarded only as a curiosity.

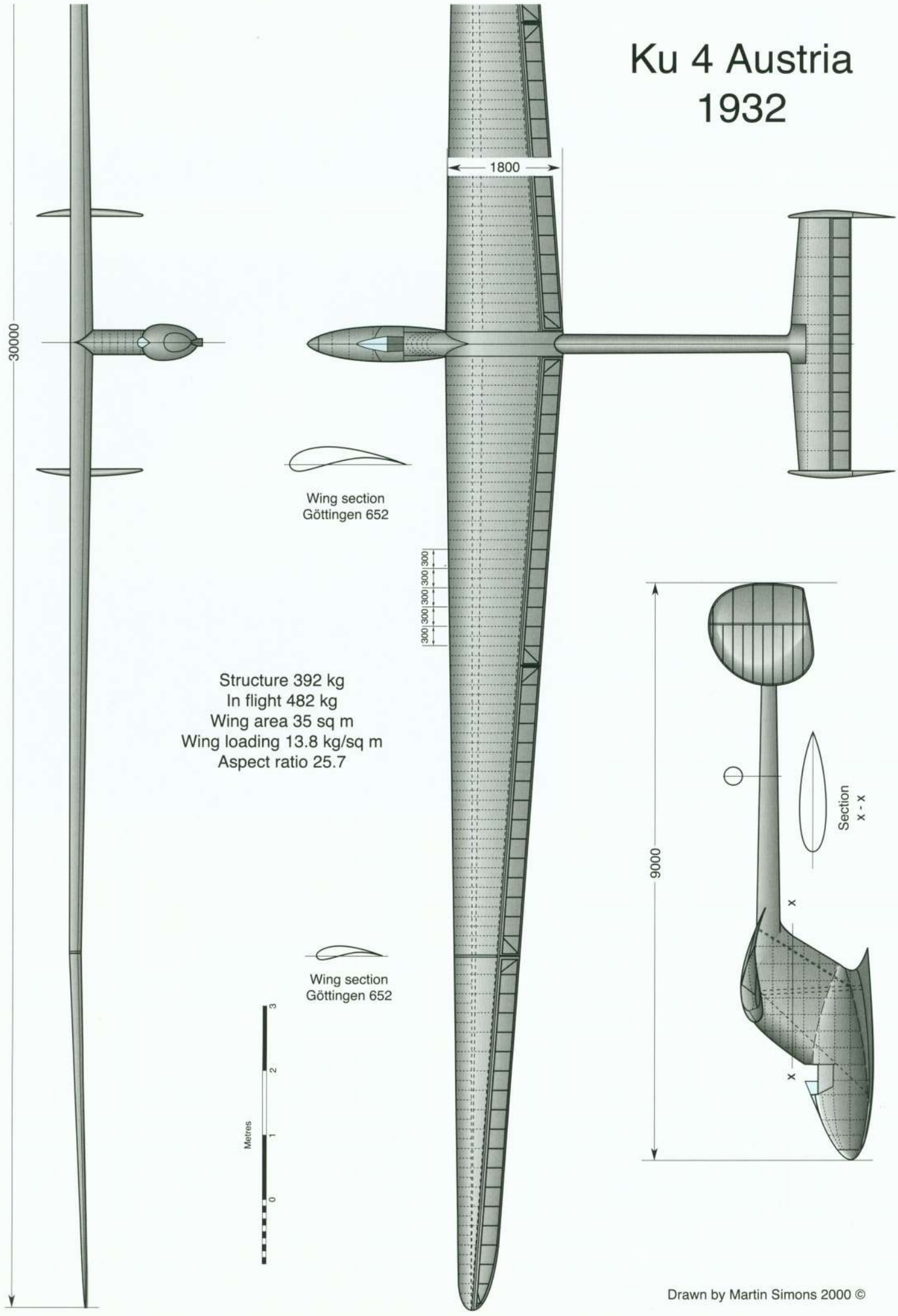
Such a long, narrow wing would bend upward under load. The tip panels were set at a slight anhedral angle so that they would take a more or less horizontal position in flight. To prevent binding at the hinges the flaperons were made in six sections, three on each side. Despite this, they gave trouble and required further work before test flights.

To give the long wing a reasonable ground clearance at the tips for landing in hilly terrain, a very tall fuselage pylon was necessary. The pilot was housed in a narrow, streamlined pod a full metre below the wing. The tail was carried on a tubular boom not much less in cross section than an ordinary fuselage. For structural efficiency this was attached at the front end directly to the main supporting structures at the wing root.

The vast wing required large tail areas for stability and control. The vertical surfaces were split into two, with outward camber, mounted on the ends of the large tailplane. Kronfeld had realised that landing an efficient sailplane was difficult and the Austria was the first ever to have a form of air brake. By pushing forward with both feet on the pedals, the two rudders could be turned outwards together, creating additional drag. These did not prove very effective and, when most desperately needed at high airspeeds, were quite useless.

To launch such a monster was difficult. For the first flights the Klemm towing aeroplane had to be assisted in the first stages of the ground run by a Mercedes truck with a 300 metre cable to get the combination moving. Once the glider was airborne the truck cable was released. Kronfeld took the Austria to England for demonstration flights at Hanworth in 1931, and was late arriving for the Rhön contest in August. When it did appear at the Wasserkuppe, because of its size and colour, it acquired the nickname Kaltgezogener Elephant.

Ku 4 Austria
1932



Drawn by Martin Simons 2000 ©

The Austria had a brief operational life. At the Wasserkuppe on 22nd July 1932 it broke up in the air. Kronfeld was lucky to escape by parachute. He had been soaring and entered a cumulus cloud, flying blind. He had a gyroscopic turn indicator but despite this became disoriented and entered a spiral dive. The airspeed rose beyond his control and the wing failed. Kronfeld survived, shaken and disappointed. The Austria was reduced to small fragments.

This was Kronfeld's last Rhön competition. He was Jewish and after 1933 forbidden to compete in Germany.

Windspiel

The Darmstadt students had not been idle after building their D - 20 Starkenburg sailplane but had turned their attention to powered aircraft. In 1933 they decided to build a thermal soaring sailplane. They supposed that good results would come from a very small, very light and manoeuvrable but efficient, aircraft that would be capable of turning very tightly in narrow and feeble thermal cores, gaining height more easily than the large span monsters. The outcome was the D - 28 Windspiel.

The span was 12 metres. The wing was tapered, with full span 'flaperons' to vary the camber for different speeds. The basic aerofoil was Göttingen 535 but thinned to reduce drag. The rudder was of an ingenious double action type. The front portion of the vertical tail was not a fixed fin but moved as a rudder. To it was hinged the rear portion, geared in such a way that it moved twice as much as the front segment. The rudder was also linked mechanically to the ailerons so that the two controls always worked together in harmony. The fuselage was reduced to the minimum possible cross sectional area with a narrow pylon to carry the wing. The cockpit was enclosed by a curved transparent piece of celluloid.

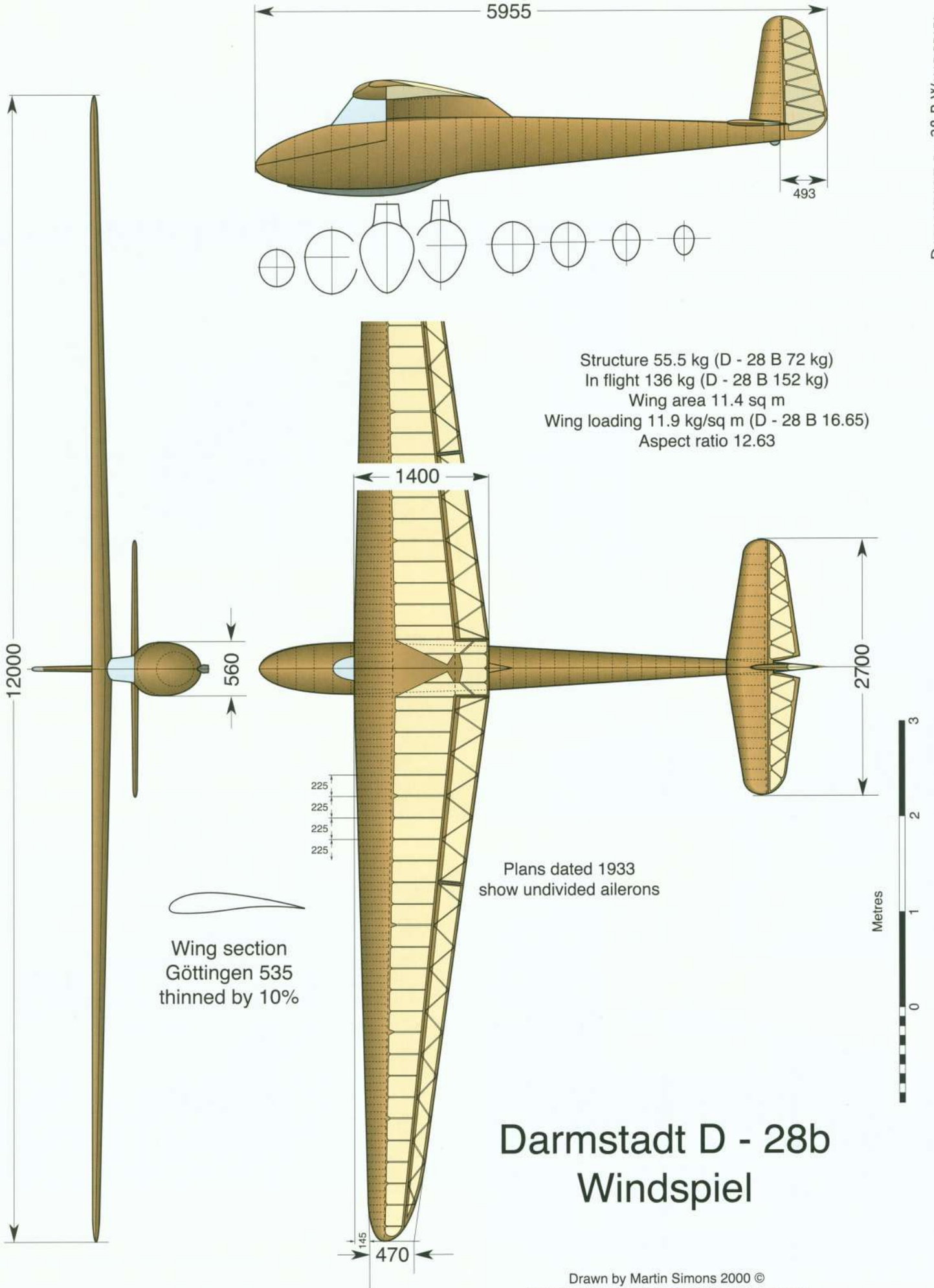
Everything conceivable was done to reduce weight. The main spar was stressed only for 4 g, the nose of the wing skinned only with 1.0 mm plywood. There was no spar to carry the ailerons, which were hinged to a few specially stiffened ribs, the gap along the hinge line sealed with 0.5 mm plywood shrouds. All wing rib members and fuselage frame outlines were spindled out to U cross section to remove waste wood and there were no fuselage longerons. Measurements were checked at every stage, dimensions kept within 0.1 mm of the calculated figures. All joints were carefully wiped before the adhesive set, to remove excess glue. Selected timber was used and metal fittings were made from light alloys. The open framework was covered with silk rather than the usual cotton or linen fabric.

Windspiel ready for launching. The horizontal bar on the mast gave the pilot a guide to the trim attitude

The students took 7000 working hours to complete the little sailplane which weighed 55.5 kg, considerably less than the pilot. It flew as expected. A shallow bank angle of 25 degrees gave a circle radius of only 80 metres.

In March 1934 the Windspiel, flown by Hans Fischer, broke the world distance record, flying 240 kilometres from Darmstadt into France, although this figure was exceeded within the month by Richard Du Pont in the USA flying the Bowlus Albatross, which represented the other school of thought. Du Pont's flight was in turn exceeded by Wolf Hirth's 352 km in July, with the 20 metre Moazagotl.

Fischer was in the cockpit on Griesheim aerodrome one day in 1935 when a powered aircraft landed on the Windspiel. He escaped with bruising, but the sailplane was wrecked. It was rebuilt, with the ailerons divided now from the flaps. The repaired structure was heavier, but the D - 28B, as it was called, suffered very little in per-



Darmstadt D - 28b Windspiel

Drawn by Martin Simons 2000 ©
Based on Akaflieg Darmstadt plans dated 1936

formance. Hans Osann made a good flight in it from Darmstadt to land just over the border of the Netherlands, 275 kilometres, and at the ISTUS (Internationale Studienkommission für Segelflug) meeting in Salzburg in 1937 crossed the Alps, one of several pilots to achieve this on the same day. The D - 28B was one of the sailplanes later taken to North Africa to investigate thermals over the Sahara.

An interesting experiment, the Windspiel did not set a trend towards small sailplanes. To build such a lightweight was very difficult, costing more in time and labour than the large sailplanes, and the results in competition were not especially good. The Windspiel was also delicate to handle on the ground, and probably not strong enough for cloud flying.

Above: The Windspiel about to take off. The figure 7 on the nose is evidently not a contest number.

Left: The D - 28B on the airfiled at Griesheim.

Right: The divided ailerons identify this as the D - 28B. Note the removable cockpit cover and the wheeled dolly for ground handling.

Chapter 8 Schneider and Grunau

Each individual sailplane coming from the Edmund Schneider, Grunau works was given an ESG number according to the year in which it was built. Every aircraft emerging during the year 1929 was an ESG 29 and so on for 1930 and 1931. This caused little confusion at the time because except for the primary trainers, hardly any two sailplanes were alike. They usually acquired individual names from owners, sponsors or advertisers, such as Donnerstag-Klub, Burkbraum, Senator, Bad Warmbrunn (two seater), Condor (two seater), Wiesenbaude 1, Wiesenbaude 2. Which year numbers were applied to which types is not always discoverable but the names were usually painted on the aircraft in large letters.

Above: The ESG - 31 in flight, Sweden 1946.

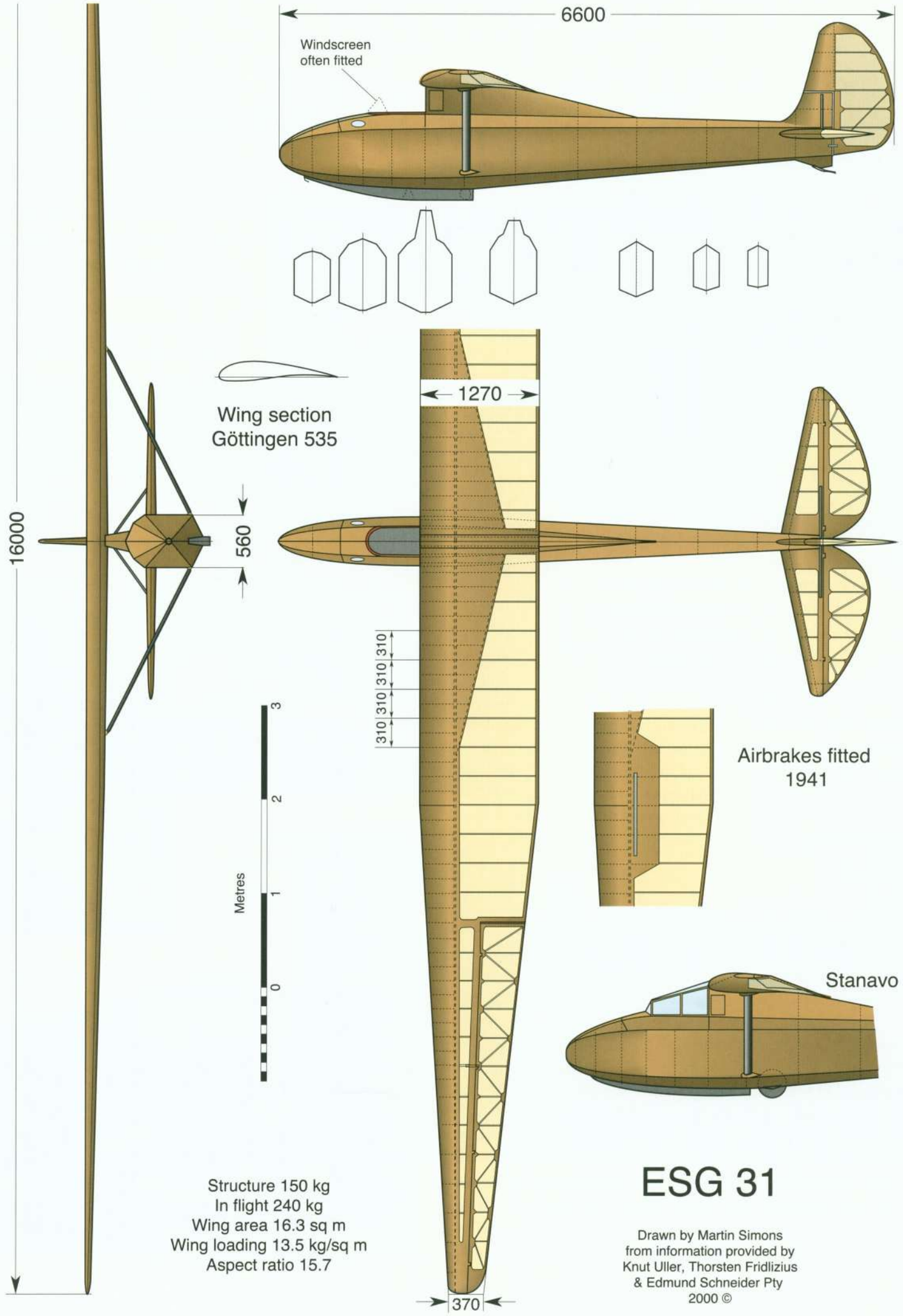
Right: Details of strutted tail of the ESG - 31 (Fridlizius).

Below: The ESG - 31 outside the Sailplane Museum Aarhus in Sweden. This is the only survivng example of the type, manufactured by Schneider in Grunau (Fridlizius).

ESG 31

Schneider recognised the need for a sailplane in the same class as the RRG Professor, capable of towed launching but easy to build and safe to fly. Among the Schneider products was a single seat, 16 metre span, strut braced sailplane which in appearance and layout resembled the Professor, with a very similar performance and role. Schneider's design was original, with a simplified wing structure, a single strut instead of the V struts of the Lippisch type, Göttingen 535 wing profiles instead of the Gö 549. The ailerons were very broad at their inboard ends and strongly tapered. With various detailed improvements this type continued in production for several years although there was no such thing as a production line. Each aircraft was custom built to order.

Most of these 16 metre sailplanes from 1929 through till at least 1931, were named by the owners, often with some advertising and/or sponsorship deal. Wiesenbaude was one such, possibly numbered ESG 29 or 30. Wiesenbaude 2 was presumably built for



Structure 150 kg
In flight 240 kg
Wing area 16.3 sq m
Wing loading 13.5 kg/sq m
Aspect ratio 15.7

ESG 31

Drawn by Martin Simons
from information provided by
Knut Uller, Thorsten Fridlizius
& Edmund Schneider Pty

Above: The Grunau Baby 1 had a straight backed fuselage and tall rudder.

Left: Wolf Hirth at the Rhön, preparing to take off in the ESG - 31 'Frankenstein'.

the same club at about the same time. Schlesierland was another but there was also a two seat Schlesierland which was of course quite different.

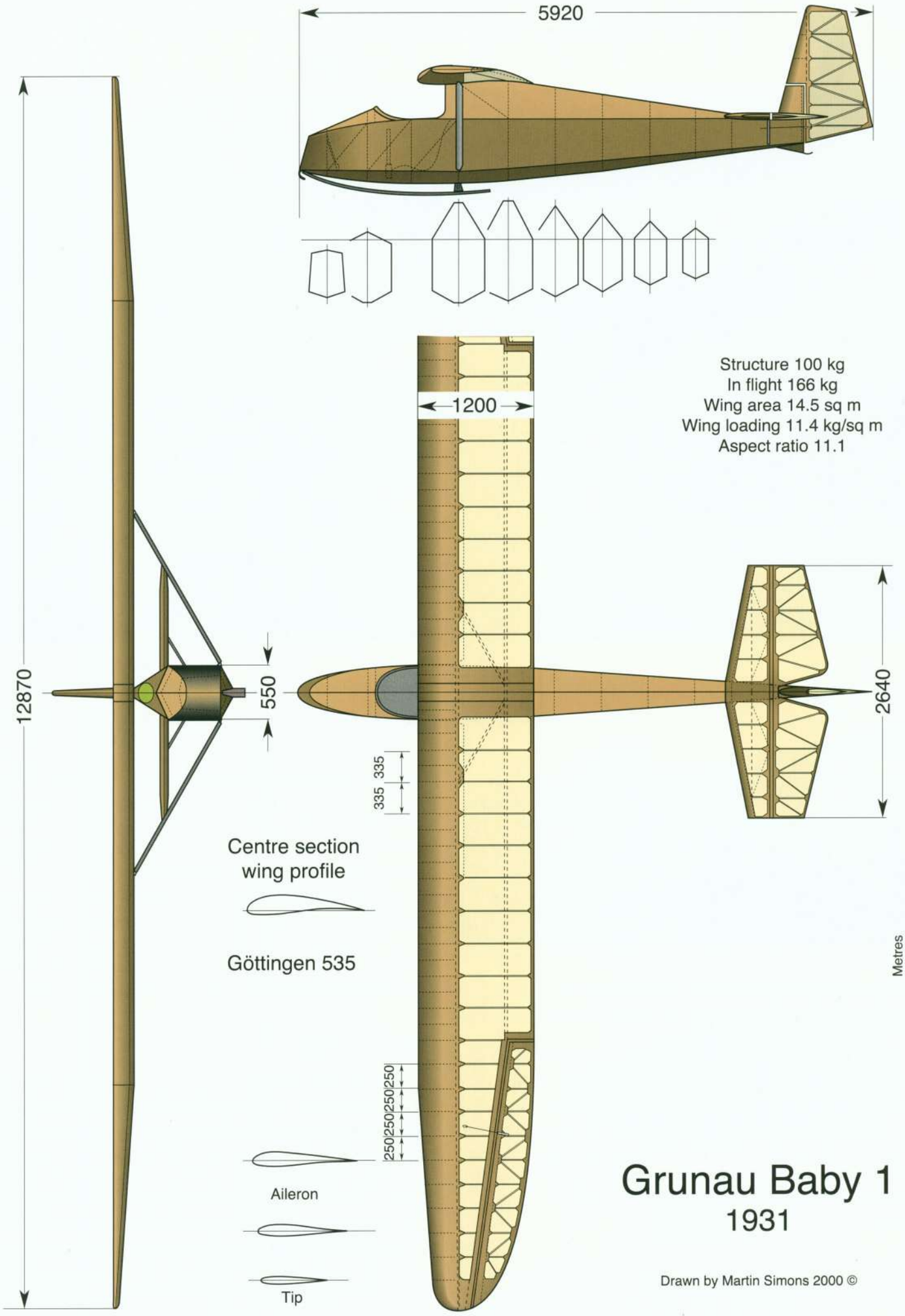
Wolf Hirth flew and liked the Schlesierland. Probably at his suggestion the next ESG 31 was the Stanavo. The wing was the same but there was a landing wheel and an enclosed cockpit similar to that of the Musterle. (Stanavo was the name of an aviation fuel marketed by the German division of the American Company, Standard Oil of New Jersay. It may be that the oil company bought it for their representative in Europe, the American sailplane pilot, Jack O'Meara.)

In 1931 the ESG 31A and 31B, both single seaters, were advertised in Schneider's brochure as 'improved Schlesierland' type. They had the same familiar strutted 16 metre wing. The new tail unit was braced with struts up to the fin. The 31B was offered with a fully sreamlined fuselage, the 31A retained the simpler hexagonal box form. At the Rhön in 1932 Hirth flew an ESG 31A named #Frankenstein', belonging to a police gliding club.

How many of the ESG 31 series were produced altogether is not recorded, but at least one was exported and this survives in Sweden. The ESG 31 'Läkerolplanet', delivered to a customer in Sweden in 1933, was used there for many years and is now preserved in the Swedish Ållebergs Sailflying Museum, registered SE - ADP.

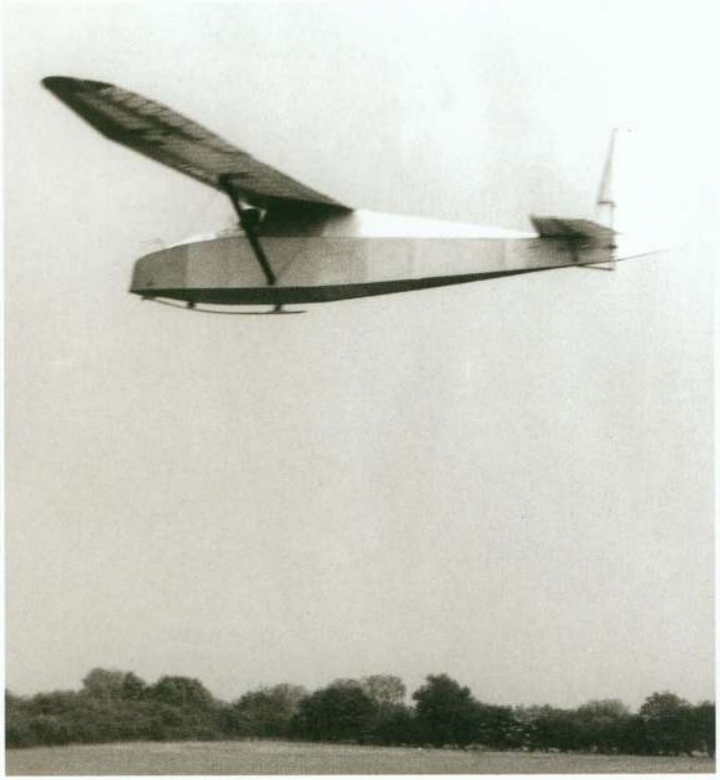
Grunau Baby

A new and very different design was started in the winter of 1930 and the prototype flew in the following year. Confusingly, it was numbered after the year, ESG 31, but did not much resemble the 16 metre ESG 31 type. The ESG 31 Grunau Baby was a modest, 12.87 metre span single seater. In plan form the two piece wing, braced with a single strut, resembled the Darmstadt sailplanes, a rectangular centre section with elliptically tapered outer panels. The Gö 535 section blended to a thin symmetrical profile, strongly washed out to control tip stalling. The fuselage was of hexagonal cross section, plywood skinned with a straight spine from the wing trailing edge



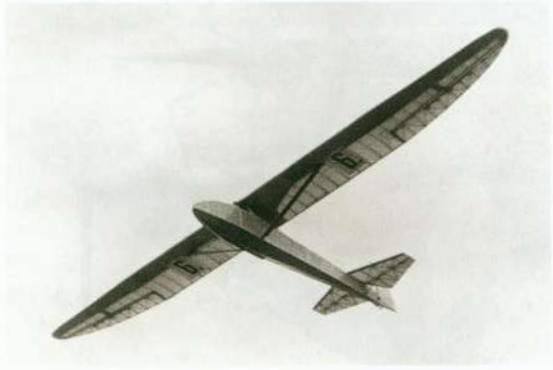
Structure 100 kg
In flight 166 kg
Wing area 14.5 sq m
Wing loading 11.4 kg/sq m
Aspect ratio 11.1

Grunau Baby 1
1931



Left: In England, A GB 1 was built at Dunstable by Louis Desoutter, who died in a Dagling accident in 1934 before it was complete. Slingsby finished it and it proved very popular with members.

Below: Hanna Reitsch went to Latin America with Georgii's expedition in 1934. She flew a Grunau Baby 2, D - Christian, which had a rounded decking to the front fuselage.

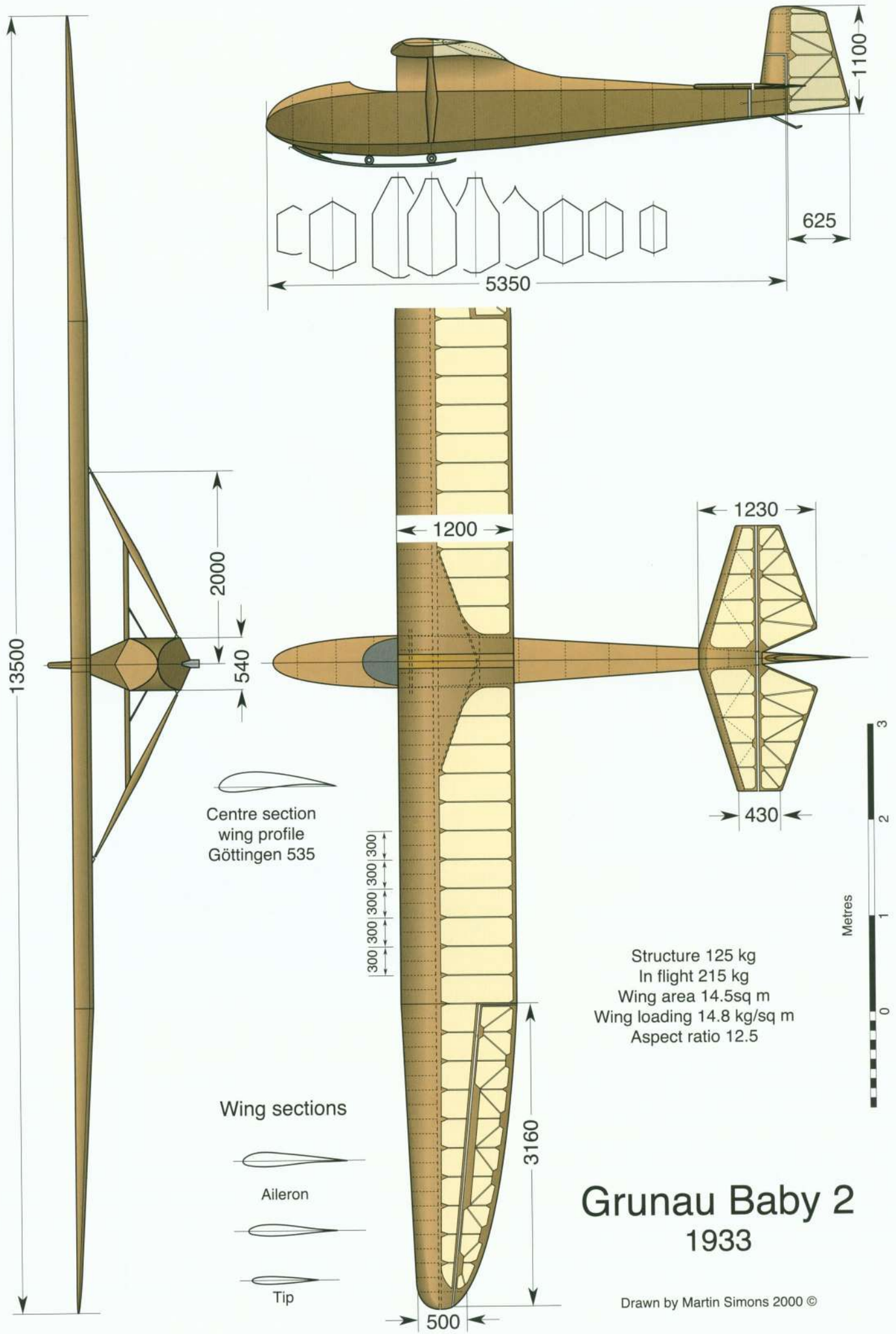


Above: Plans for the GB 2 were sold and numerous examples were built all over the world. Slingsby built fifteen under licence, one which is shown here. Note the broad ailerons.

to the tail. The tail unit was very simple, the tailplane struts underneath and the tall rudder aerodynamically balanced. Gaps, 25 mm wide, at all hinges of the control surfaces were closed with strips of fabric doped on. The cockpit was open with no windshield. A skid was provided for landing. Flight tests proved the Baby was exactly what Schneider had hoped.

Wolf Hirth, after his success at Elmira and the flight over New York city, returned from the USA in 1931 and went to Grunau to take charge of the gliding school. The prototype Grunau Baby was already flying when he arrived and saw it for the first time. At Schneider's request, Hirth endorsed the type and allowed his name to appear, somewhat ambiguously, in advertising brochures. The legend began that Hirth was the designer, which he himself never claimed. Further confusion was caused by the association of Hirth with the Stanavo, and Schneider's system by which the Stanavo and the much smaller Grunau Baby were both numbered ESG 31. The Stanavo actually made its first flights after the Grunau Baby prototype, but both in 1931.

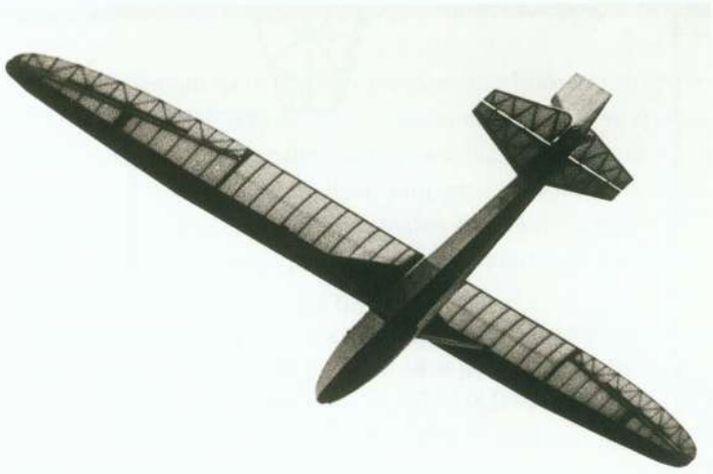
The Grunau Baby was an immediate success and Schneider began production. Not only the Grunau school but clubs all over Ger-



Structure 125 kg
In flight 215 kg
Wing area 14.5sq m
Wing loading 14.8 kg/sq m
Aspect ratio 12.5

Grunau Baby 2
1933

Above: A Grunau Baby 2A in Yugoslavian markings.



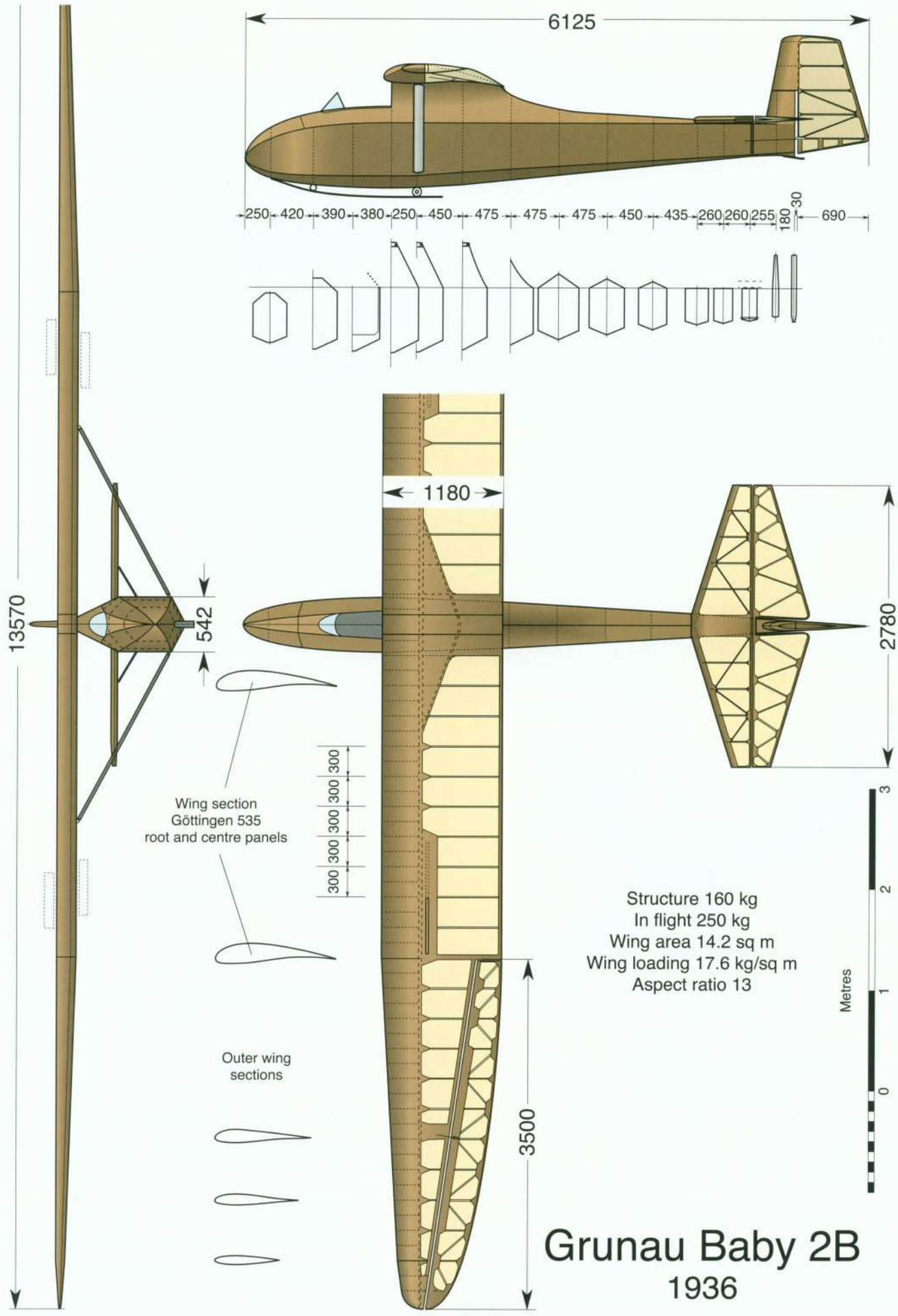
Left: The Grunau Baby 2A, which had narrower ailerons, a revised elevator shape and spoilers above the wing, was widely distributed. The example shown here was exported to Australia in 1937.

many and elsewhere placed orders. Six Grunau Babies entered the Rhön competitions in 1932 and by the end of the year twenty two had been sold. Sets of plans were made available for amateur and other production.

Schneider, although a skilled craftsman with good experience of sailplanes, had no formal training as an engineer. One of his sailplanes, the Senator flown by Herbert Rüdiger, broke up in the air over the Wasserkuppe in 1932, with fatal results. It was suspected that the wing was under strength. Taking warning, Schneider employed Emile Rolle, an engineer, to carry out essential stressing and redesign of the Baby. As well as the necessary strengthening, Rolle extended the span, improved the fuselage shape by curving the spine behind the wing, enlarged the cockpit and produced the Grunau Baby 2.

The success of this type exceeded all expectations. Its appearance on the market came at the right time. It was inexpensive. The handling was adequate for beginners yet 'Silver C' flights (five hours duration, 1000 metres gain of height, and 50 km distance) were quite within reach. Sales improved even more when Kurt Schmidt, above the famous Baltic coastal sand dunes at Rossitten, soared a Grunau Baby 2 for a world record duration of more than 36 hours. At the 1933 Rhön, thirty three Grunau Babies entered. By the end of that year Schneider was producing a GB2 every three days. Licence production was undertaken in several countries and amateurs in many distant places started building.

Further improvements came in 1935, with the Grunau Baby 2A. The ailerons were increased in length and reduced in chord, lightening the stick loads for the pilot but improving their effectiveness. The elevator was reshaped, the cockpit was given a semi-enclosed canopy with windscreen, and spoilers were introduced. The need for these to help landing had now been recognised.



Grunau Baby 2B
1936

Drawn by Martin Simons 2000 ©

With the Grunau Baby 2B came genuine dive brakes of the 'scissor' or 'parallel ruler' action. Vertical blades extended above and below the wing, giving the pilot a very powerful control of the glide and also limiting the airspeed if the sailplane, in cloud or aerobatics, should get out of control. These brakes were developed originally by Schempp Hirth, the company set up by Martin Schempp and Wolf Hirth in 1935.

The Grunau Baby 2B was taken up by the National Socialistische Flieger Korps (NSFK), the flying division of the Hitler Youth organisation. At hundreds of small gliding schools the 2B became the standard intermediate sailplane. Whatever the numbers before, the production figures of the GB 2B ran into thousands. Harry Schneider, son of Edmund, estimated about 4000 to 5000 Grunau Babies were built, worldwide. Wolf Hirth suggested twice these figures. The exact total is not known but (excluding the innumerable primary trainers) there is no doubt that more of the Grunau Baby were built than any other type of sailplane before or since.

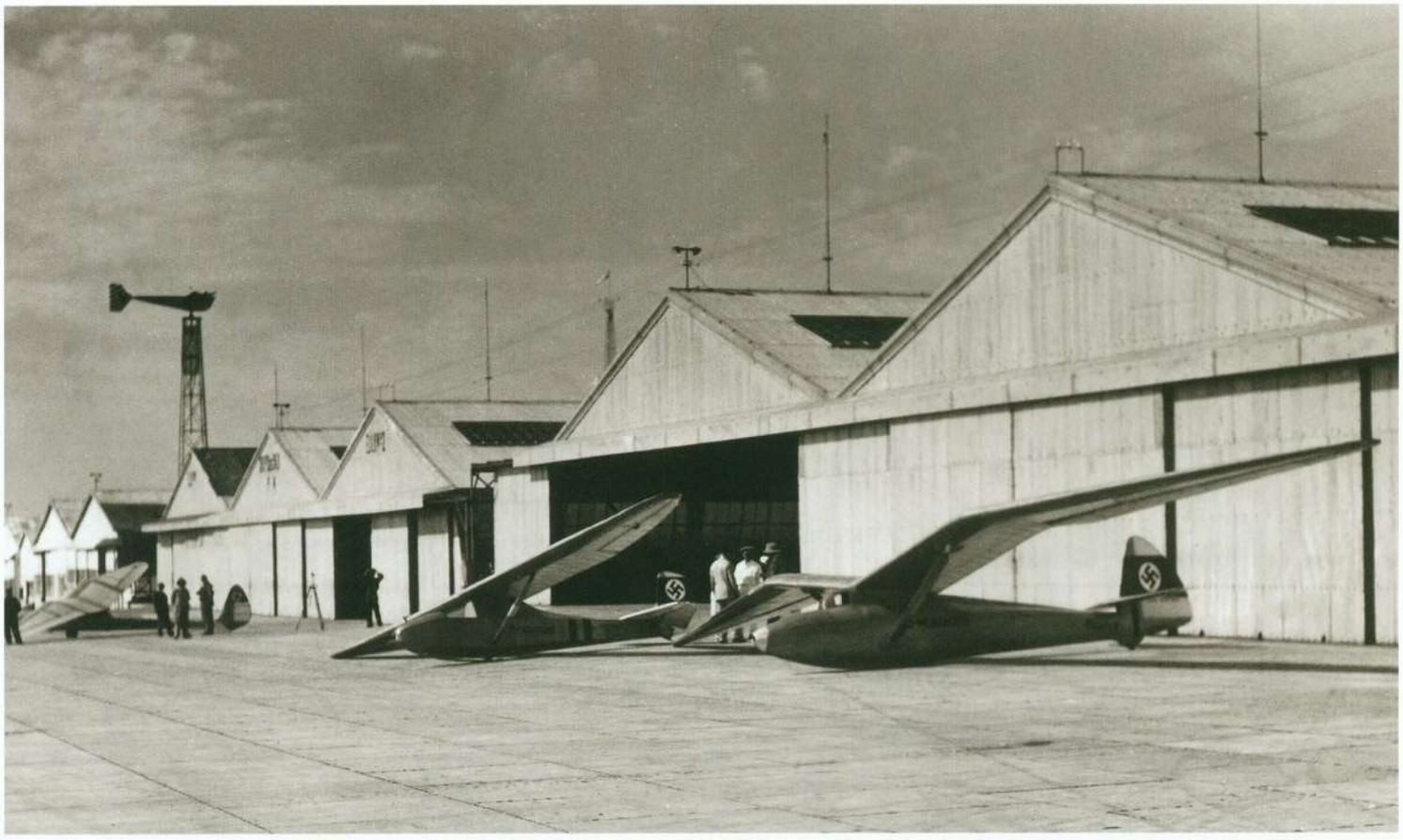
The Grunau Baby had a great influence on sailplane design and production throughout the world. It was widely copied and production outside Germany continued after World War 2, with various minor alterations. In Germany the Grunau Baby 3 was later built in some numbers, with a wheel, a more robust and rather less elegant fuselage and simplified wing mounting arrangement. Many Grunau Babies of different marks remain in service and there are 'Baby Treffens' (meetings) for enthusiasts.

Above: A Grunau Baby 2B in wartime colours, the upper surfaces camouflaged, prepared for take off.

Right: The Grunau Baby 2B was equipped with dive brakes and was mass produced in Germany and other countries. Many remain in use, carefully maintained and restored by their owners, in many countries.

Moazagotl

Wolf Hirth understood before most others that stability was a necessity especially in steep circling flight. The Musterle was sensitive in pitch and had no dihedral so was difficult to handle in thermals. He wanted a sailplane which would be capable of long continued circling, in clear air and in cloud, without constant corrections, strong enough to withstand violent turbulence, and with a good performance, meaning large span and high aspect ratio.



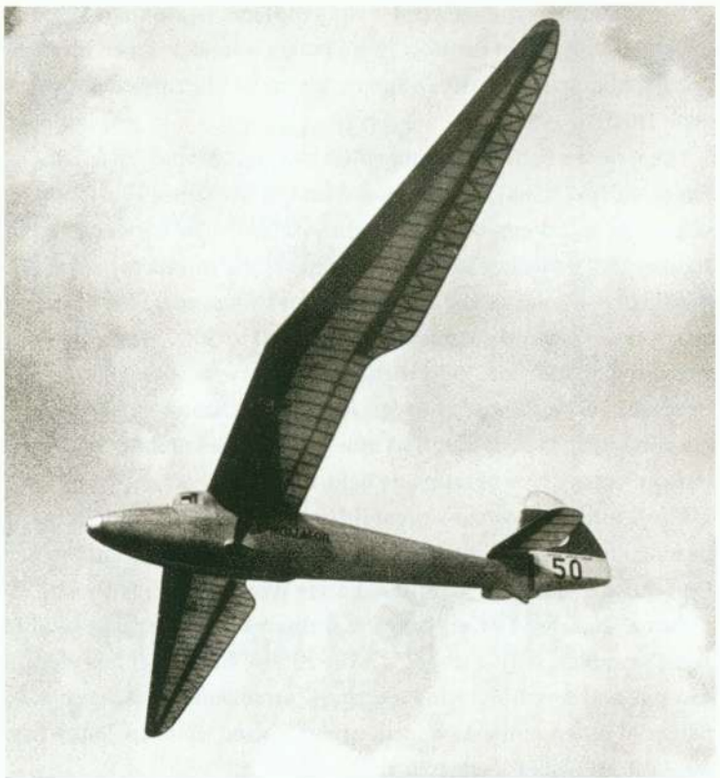
Hirth had also realised that on the best soaring days, when there were plenty of strong thermals, it paid to move fast through sinking air. Even if this caused some sacrifice of height in the short term, the faster sailplane would reach the next thermal and be climbing while the slower competitor was still wallowing in the sink far behind. His new sailplane must be capable of carrying ballast. A tank taking 50 kilograms of water was to be fitted behind the pilot's seat. A valve would allow him to jettison the water if conditions became difficult.

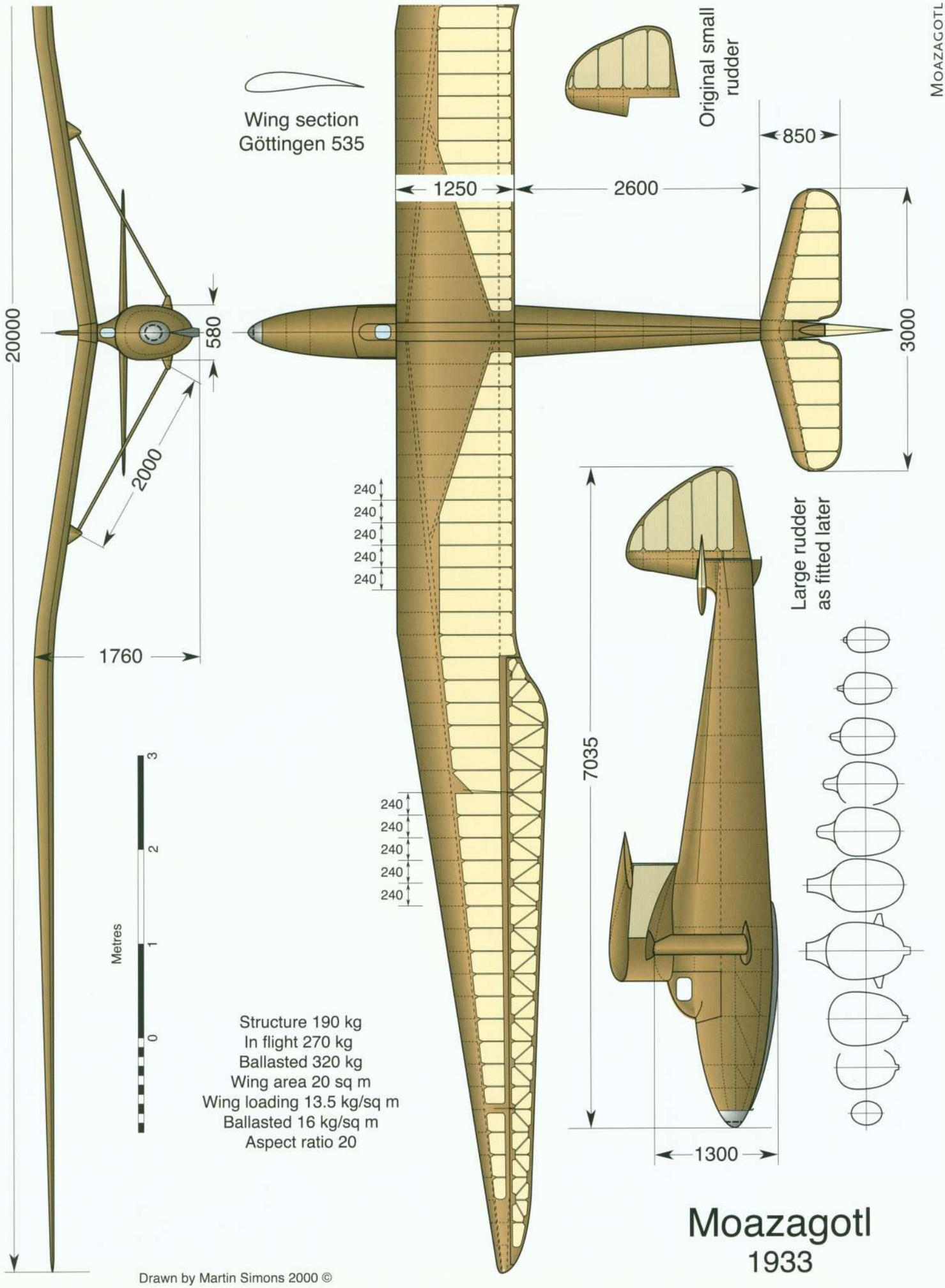
In 1932 Hirth commissioned Friedrich Wenk to design, and Schneider to build, the Moazagotl. The name came from a local legend. A Silesian peasant called Gottlieb had noticed and wondered about a strange, stationery cloud, Motz Gottlieb's cloud, corrupted to Moazagotl, that formed sometimes over the valley where his farm lay. The south west wind blew hard all day but the cloud remained where it was. Hirth's attention was drawn by the director of the Krietern Meteorological Observatory near Breslau, to the phenomenon. Grunau pilots in March 1933 were the first anywhere to use wave lift for soaring.

Completed in time for the 1933 Rhön competitions, the sailplane had a strongly arched 'gull' form wing with sweep back over the outer panels, which harked back directly to Wenk's tailless Weltensegler of 1921. Much had been learned in the intervening decade. With a span of 20 metres the wing was strong, strut-braced and had a high degree of inherent stability, combined with an excellent performance. The most difficult feature of its construction

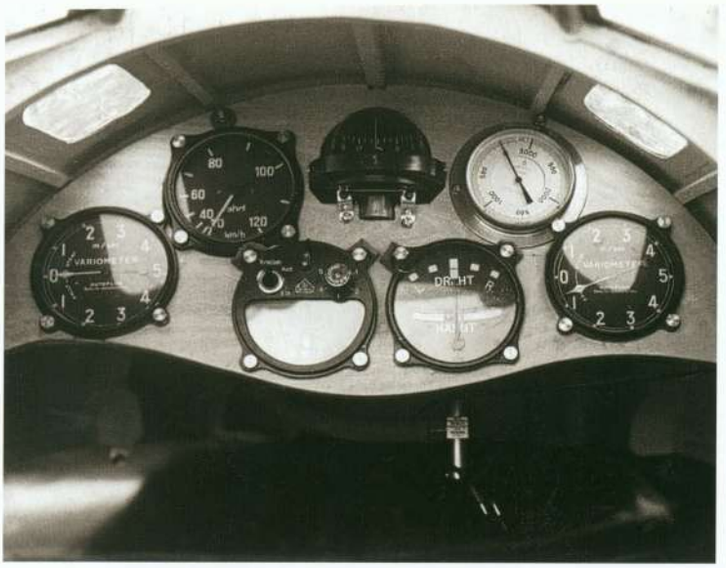
Above: The Moazagotl in Latin America, El Palomar airport, Buenos Aires, with the Grunau Baby.

Below: The Moazagotl in flight





Moazagotl
1933



was the pronounced bend in the main spar at the inner end of the ailerons, just at the point where the sweepback began. Wenk avoided the awkwardness here by continuing the main spar in a straight line, when seen in plan view, all the way to the root. Thus, only a simple bend was required. Together with the diagonal sub-spar and the struts a very strong, yet light, trapezoidal frame resulted. The wooden cockpit canopy, like that of the Musterle, was provided with portholes and small windows. Hirth found the aircraft up to his expectations, except that the original rudder proved inadequate. The long wings with the very large ailerons required greater control power in the yaw plane. A larger rudder was built and fitted.

The performance was good and with it Hirth made the longest flight of the 1933 competition, 180 kilometres, and the following year he was the second sailplane pilot to achieve a distance flight of 300 kilometres. Ludwig Hofmann flew the Moazagotl in the 1937 International Competition, recognised as the first World Championship. He placed second. The Moazagotl was deliberately burned at the Hornberg in 1945, to prevent it falling into the hands of the advancing American armies.

The Schneider family, Edmund, his wife and two sons Edmund Jr and Harry, were compelled to leave Silesia in 1945. Production of some of their designs, including the Grunau Baby, continued there under Polish rule. The family eventually re-established their business near Adelaide, in South Australia. The ES Grunau Baby 4, several of which were built there, was only distantly related to the original.

Left above: The Moazagotl instrument panel. Top row: airspeed indicator, compass, altimeter. Bottom row: variometer, electrically driven turn indicator, venturi-driven turn indicator, variometer.

Above: The Moazagotl suspended in the roof of the hangar on the Hornberg. It carries its later colour scheme.

Right: The Moazagotl in Latin America, El Palomar airport, Buenos Aires

CHAPTER 9

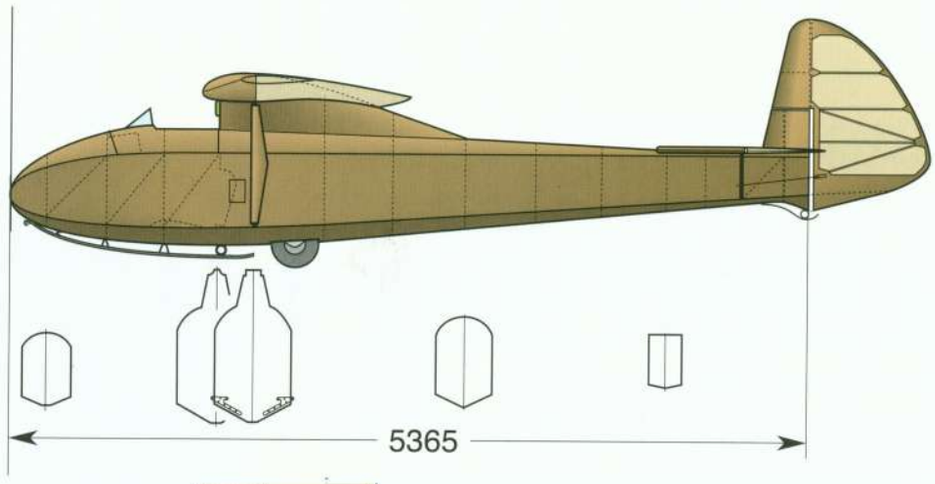
Schempp Hirth

For aerobatic displays, the Wolf often had a 'sunburst' colour scheme. The narrow chord ailerons are fitted here.

Göppingen 1, Wolf

In 1935 Wolf Hirth decided to set up, with Martin Schempp, his own manufacturing Company in Göppingen, about 50 kilometres east of Stuttgart. Their first product was the Göppingen 1 Wolf. It was aimed at the same market as the Grunau Baby and was very similar, but with improvements. The fuselage, with narrow neck and rounded decking ahead of the cockpit, resembled that of the Stanavo, and there was a wheel. Hirth and Schempp, during their American experience, had appreciated the need for this as an aid to ground handling, aero towed and winch launching, which were now the norm. The ailerons were large with lobate form in plan view. The tail unit was given a rounded shape. The Wolf was stressed for aerobatics and could, if required, be fitted with V struts to give extra stiffness to the wing, allowing higher airspeeds. The first Wolf was sold to England and toured with Alan Cobham's Air Circus for some years, putting on aerobatic displays. Joan Meakin

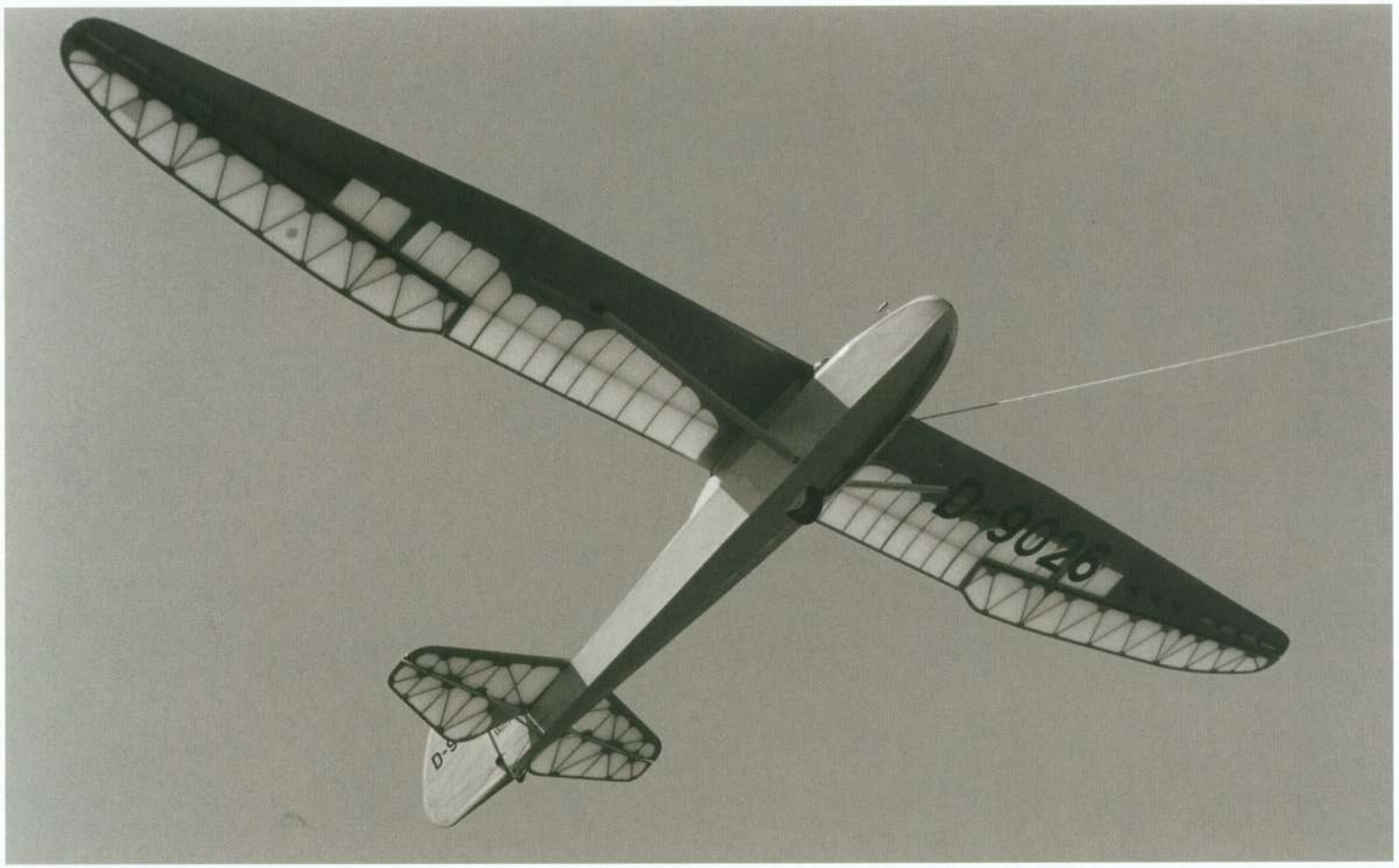
The Göppingen 1 Wolf was a rival to the Grunau Baby but was different enough to prevent confusion. The example shown here had the original broad ailerons.



Structure 145 kg
In flight 220 kg
Wing area 15 sq m
Wing loading 14.66 kg/sq m
Aspect ratio 13

Göppingen 1 Wolf
1935

Drawn by Martin Simons 2000 ©



Above: To improve the stalling and spinning behaviour of the Wolf, slotted wing tips were introduced. D-9026 is a replica built by Otto Grau, seen here at Oberschleissheim in 1995.

Left: Wing tip showing the slotted ailerons.

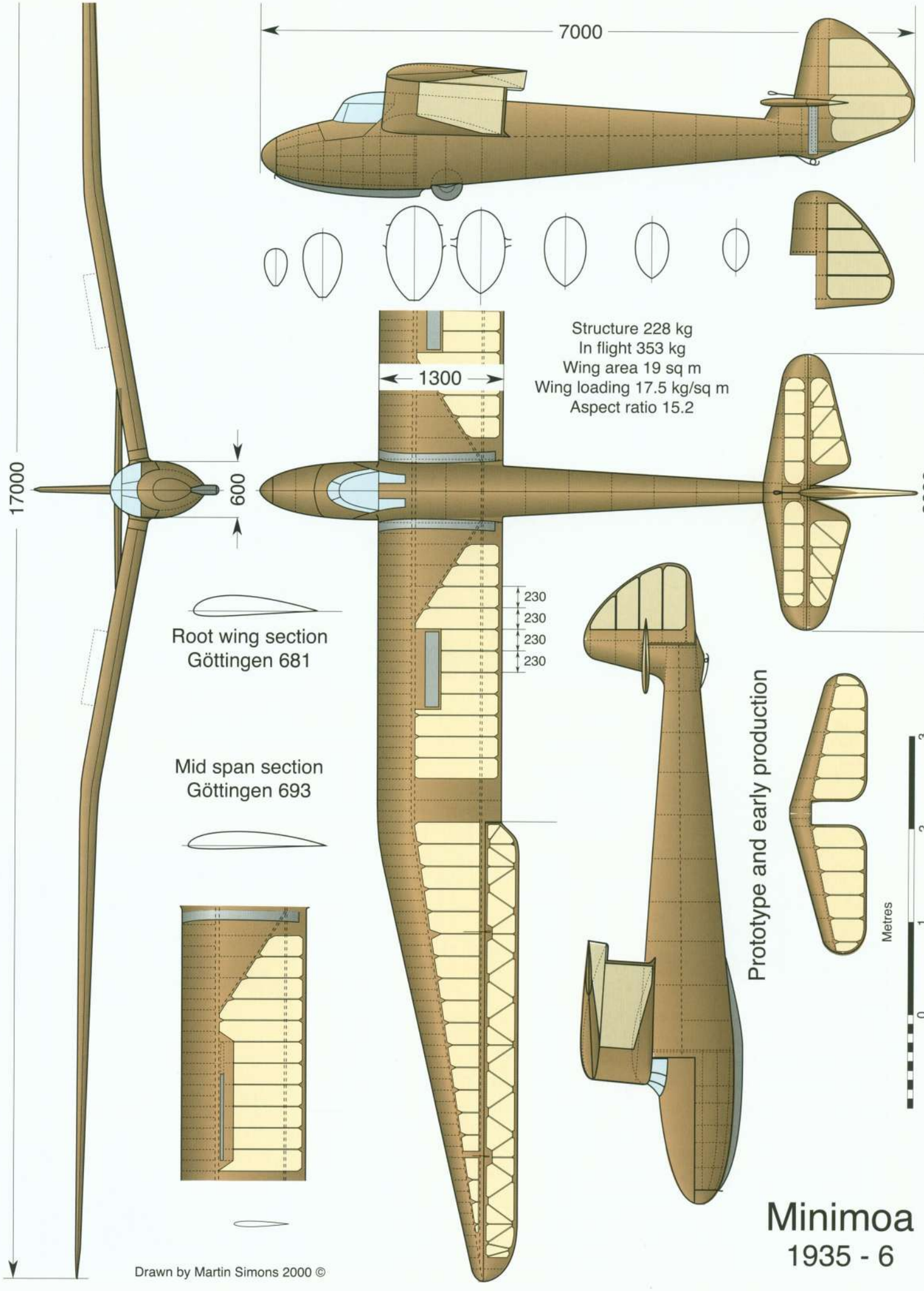
Right: Minimoa bungee launched.

Göppingen 3, Minimoa

The Göppingen 2 was a two seat training sailplane. Schempp and Hirth needed to offer a high performance sailplane of moderate price. The Moazagotl was very good but twenty metres span was too

was the pilot. The third went to the USA and Hirth took one to Japan when he toured that country in 1935 and it was sold there. Later three more of the type were exported to Japan.

The Wolf never succeeded in displacing the Grunau Baby. The type gained a reputation for spinning dangerously. In 1936 a version with redesigned ailerons of narrower chord appeared. The bad reputation was probably undeserved, a result of construction errors in some factories building the Wolf under licence. In 1938 the German authorities grounded the type, pending a complete redesign of the outer wings with slotted ailerons. This was done but the cost of modification was too much and most of them were scrapped. Very few survive today.



Minimoa
1935 - 6

Minimoa launched from the Wasserkuppe.

large and costly for the expected market. Seventeen metres seemed more reasonable but the possibility of offering the aircraft with alternative spans, 16, 17 and 18 metres, was considered seriously. With a cantilever wing there would be a worthwhile saving in drag. For cloud flying the structure was stressed for a load factor of 10 instead of the usual 8. The extra weight of material required would be useful for faster flying on good days. The main spar was required to curve in two planes where the sweep back and the dihedral bend coincided. This presented difficulties in construction, overcome with special jigging.

To retain the stability and safe handling of the Moazagotl, the new sailplane had the same general features, a swept back wing with pronounced gull dihedral, large ailerons and strong washout, mounted high on the fuselage. When seated, the pilot's head was inside the wing, so outward vision was not good. A window in the roof helped a little. Landings would be on a skid. Split flaps were installed beneath the wing to aid landing in small spaces.

Because of his artificial leg, Hirth had the controls set up with an overhanging control column working a torque tube which passed over his right shoulder to bell cranks in the wing root. The entire top front of the fuselage lifted off to allow him to get in and out. This was not expected to continue with production aircraft.

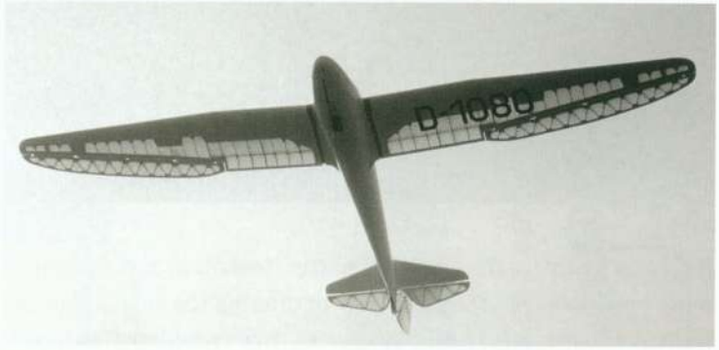
This unusual prototype flew in 1935 and was taken to the Rhön meeting. Perhaps it was inevitable that the Göppingen 3 , a smaller version of the Moazagotl, should be called the Minimoa. The first Minimoa accompanied Hirth when he visited Japan to demonstrate and promote soaring later in 1935, and was sold there.

A second prototype was built, with a landing wheel and normal controls. This too went to Japan later. One more of the high winged version was built and sold to a Romanian pilot.

After this there was some substantial redesign before production began. The wing was mounted lower on the fuselage with a new, much improved cockpit canopy giving the pilot a better view. The tail unit also was redesigned with a fixed tailplane instead of the all moving elevator of the prototypes. Various sizes and types of rudder were tried at different times. The landing flaps were replaced by spoilers and eventually, on later models, air brakes.

A Minimoa was exported by Zeppelin to Argentinia, seen here unloaded from the airship.

Right: The long fuselage Gövier D - 1080, restored was flying at Elmira, USA, in 1995.



Production began in 1936. There is no doubt the Minimoa was everything Hirth had hoped for, stable and strong with a good performance. The best glide ratio was measured at 25.7:1 in 1938. This was probably no better than contemporary sailplanes of similar span from other designers and factories, but, because of its very distinctive and graceful shape, the Minimoa became very well known and admired. Minimoas were exported, two to England, two at least to America, another to South America, one to South Africa, others to France as well as Japan. The inherent stability was a popular feature. In one of his record breaking height climbs in cloud, Philip Wills in England, beginning to feel disoriented, recited to himself 'Mini Moa is always right!', took his hands and feet off the controls and the sailplane settled down to fly itself perfectly. Records and competitions were won, orders continued to come in and a total of 100 Minimoas was reached by 30th June 1938. More were built after this, stopping only late in 1939.

A two seater was produced in 1938 but not put into production, and later there was an 18 metre experimental version with no landing wheel, in an effort to gain a little more performance.

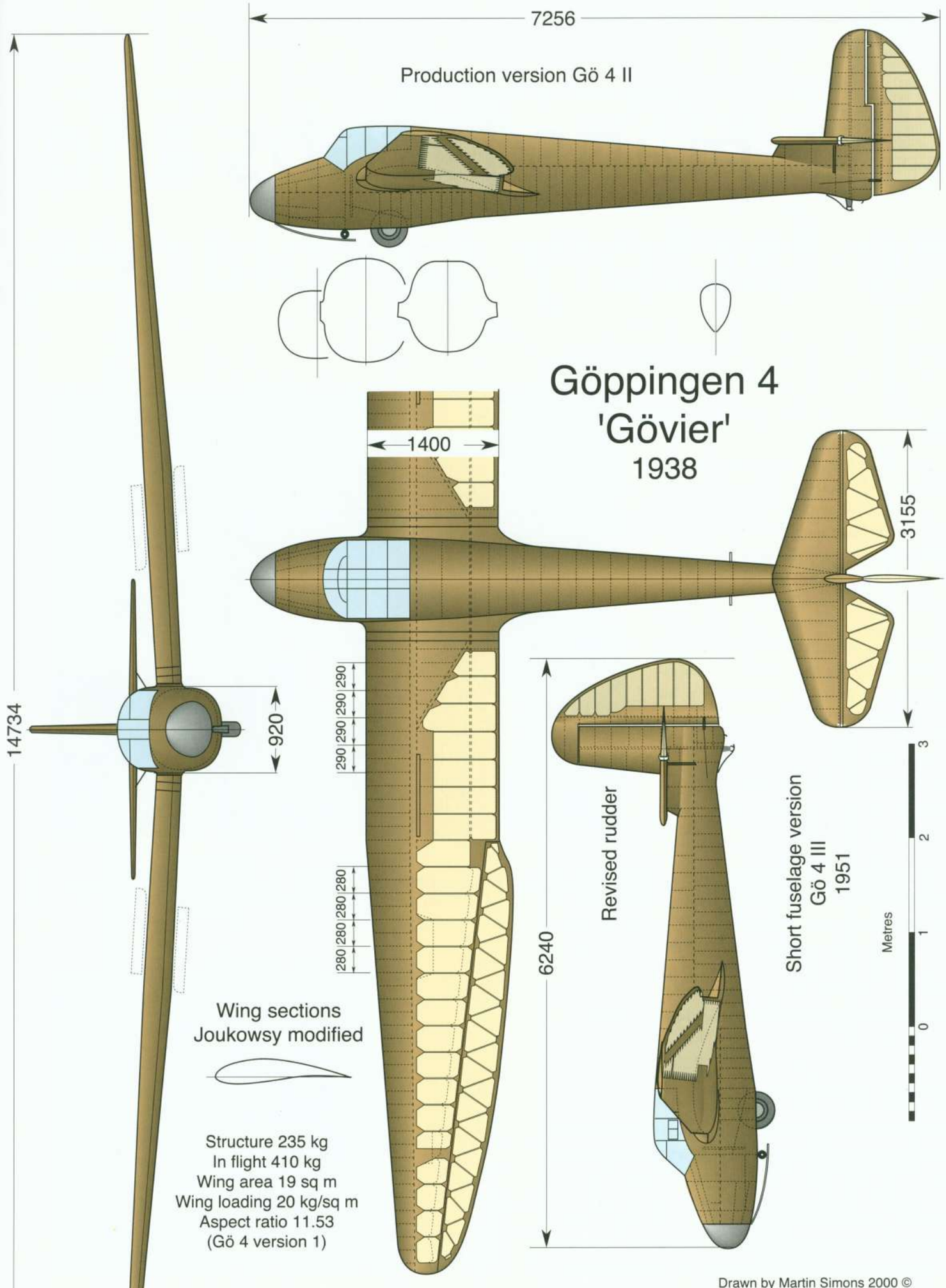
Several Minimoas survived the Second World War and most of these are still flying or at least preserved in museums.

Göppingen 4, 'Gövier'

The Gövier a two seater with side by side seating, designed by Wolfgang Hütter and Hirth together, came from the Göppingen factory in August 1938 and entered production in October. Company records suggest that more than 100 were built, there may have been more.

In the Gövier the fuselage width was reduced slightly because the wing root fairings gave a little more room for the shoulders. It was in any case intended as a training aircraft so the glide ratio of about 20:1 was acceptable. A Gövier was used as test aircraft when Schempp Hirth were developing their 'parallel ruler' type airbrakes which in the long run became almost universal for all sailplanes.

A modified version, the Gövier V2 was produced, with a much shortened fuselage, in 1941 and this led to the Gövier 3, some 20 or so of which were produced after the end of World War 2. A few remain in service.

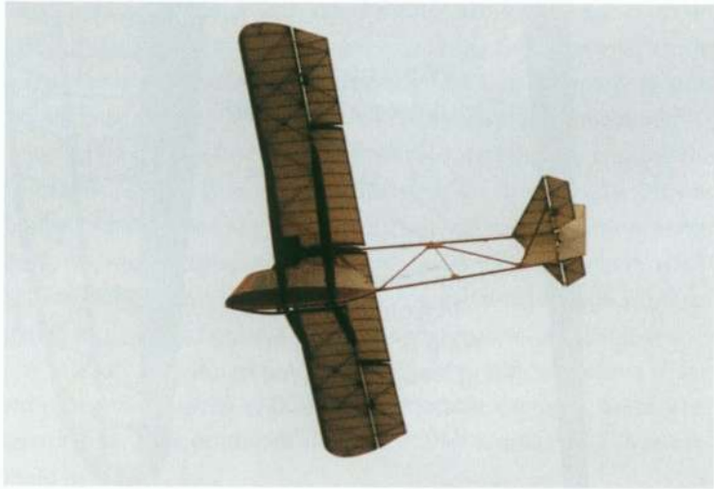


Chapter 10 Hans Jacobs and the factory sailplanes

The old organisation of the Rhön Rossitten Gesellschaft was dissolved in 1933 and replaced by the DFS (Deutsche Forschungsanstalt Für Segelflug), under the control of the central government. Georgii, who had headed the RRG, opposed the change but his resignation was refused and he was placed in charge of the reorganised research institute at Darmstadt Griesheim airfield. Among those working for the RRG, was Hans Jacobs. He had come as a young assistant to Lippisch in August 1927 and was involved closely with the experiments leading to the tailless sailplanes. He helped with the design of the Wien and the Fafnirs. Lippisch and Jacobs were compelled to leave the Wasserkuppe to join the DFS. Darmstadt became their base for the next few years. Lippisch soon handed over control of sailplane development to Jacobs.

There were factories building sailplanes before 1930 but although these produced quite large numbers of primary trainers and some secondary and intermediate sailplanes, there was no attempt at mass production of high performance sailplanes. The first move in this direction was taken by Alexander Schleicher, whose location in the valley below the Wasserkuppe enabled him to keep in close touch with the leading pilots, instructors and technical people.

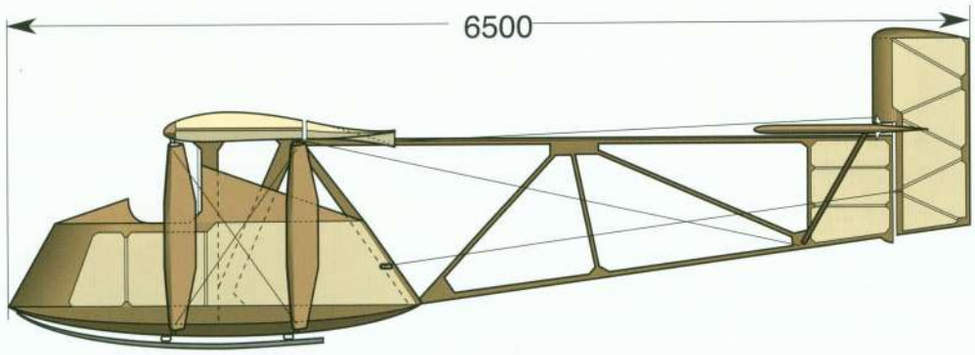
Using the original drawings produced by Hans Jacobs, Mike Beach constructed and flew this perfect example of a Hols Der Teufel in 1990. It is shown here on the ground and in the air at Dunstable.

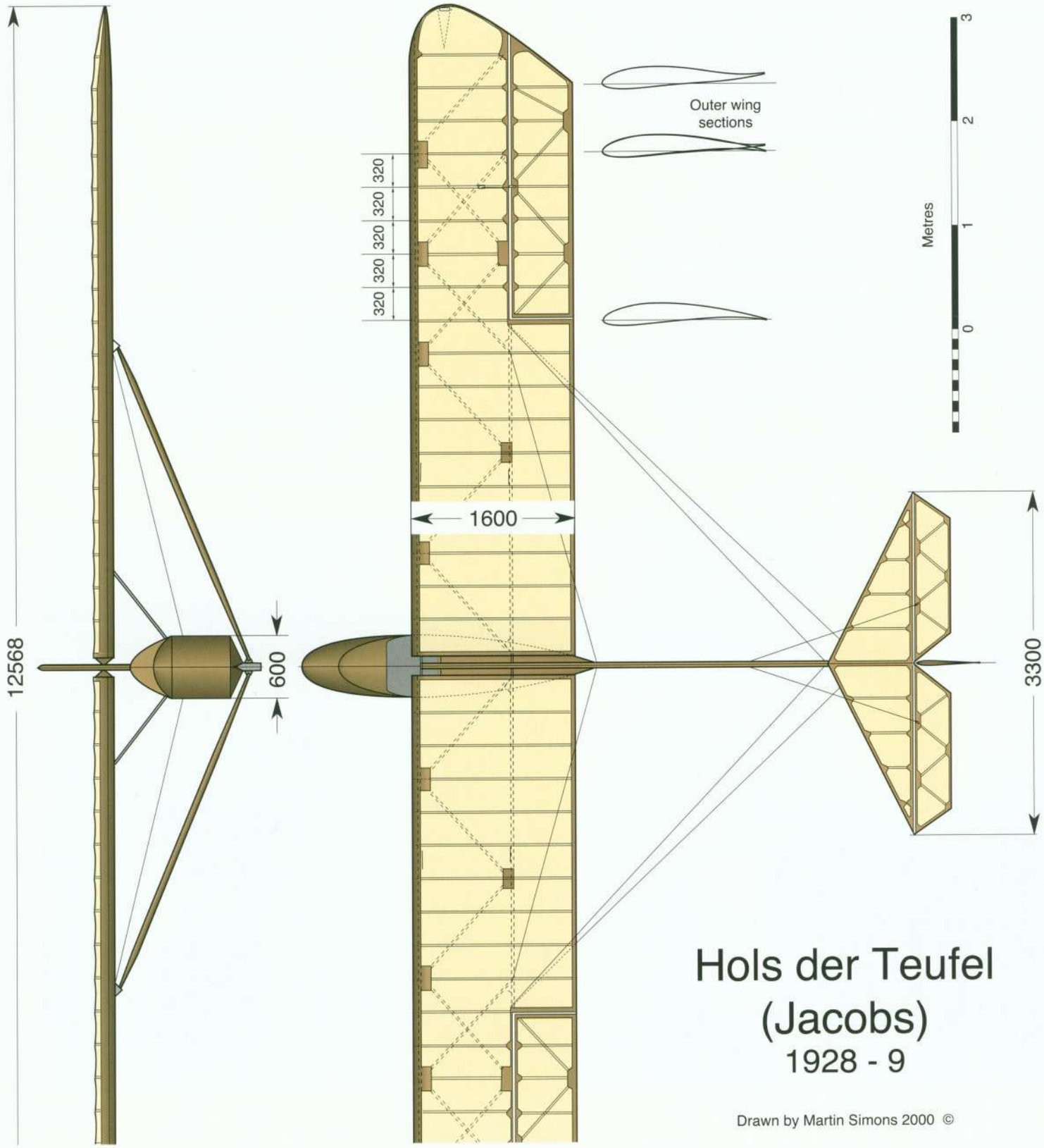


Jacobs 'Hols der Teufel'

Jacobs wrote several small books about flying models with construction plans, including tailless sailplanes. The book Segelflugzeug, issued by publisher Otto Maier of Ravensburg as Number 138 in the hobby series, Spiel und Arbeit (Play and Work) explained how to build a full scale glider. In a pocket at the back on four large sheets, were plans for a 12.56 metre glider, described as developed from the original design of Lippisch and built now by Alexander Schleicher.

Wing area 19.52 sq m
Aspect ratio 8.1





Hols der Teufel (Jacobs) 1928 - 9

The Djävlar Anamma of Alex Lippisch, usually called Hols der Teufel in German, bore little resemblance to the type so named and advertised after 1928. This was really an enlarged Zögling with struts instead of wire bracing, with a fabric and plywood nacelle for the pilot. There was no 'skullsplitter' strut. How closely Schleicher had worked with Jacobs and Lippisch on this design is not known. The plans included in Jacobs' book differed again in some details from the drawing in Schleicher's brochure; rounded wing tips, slightly different span, rudder area, altered cross bracing of the rear fuselage frame, tailplane struts rather than wires, etc. Since the Jacobs plans were readily available, his design was taken up and examples built by amateurs in many countries. It was usually called Hols der Teufel although Jacobs himself did not give it this name. A modern replica was built by Mike Beach in England, flown successfully, and is now preserved in the Wasserkuppe museum.

Luftkurort Poppenhausen

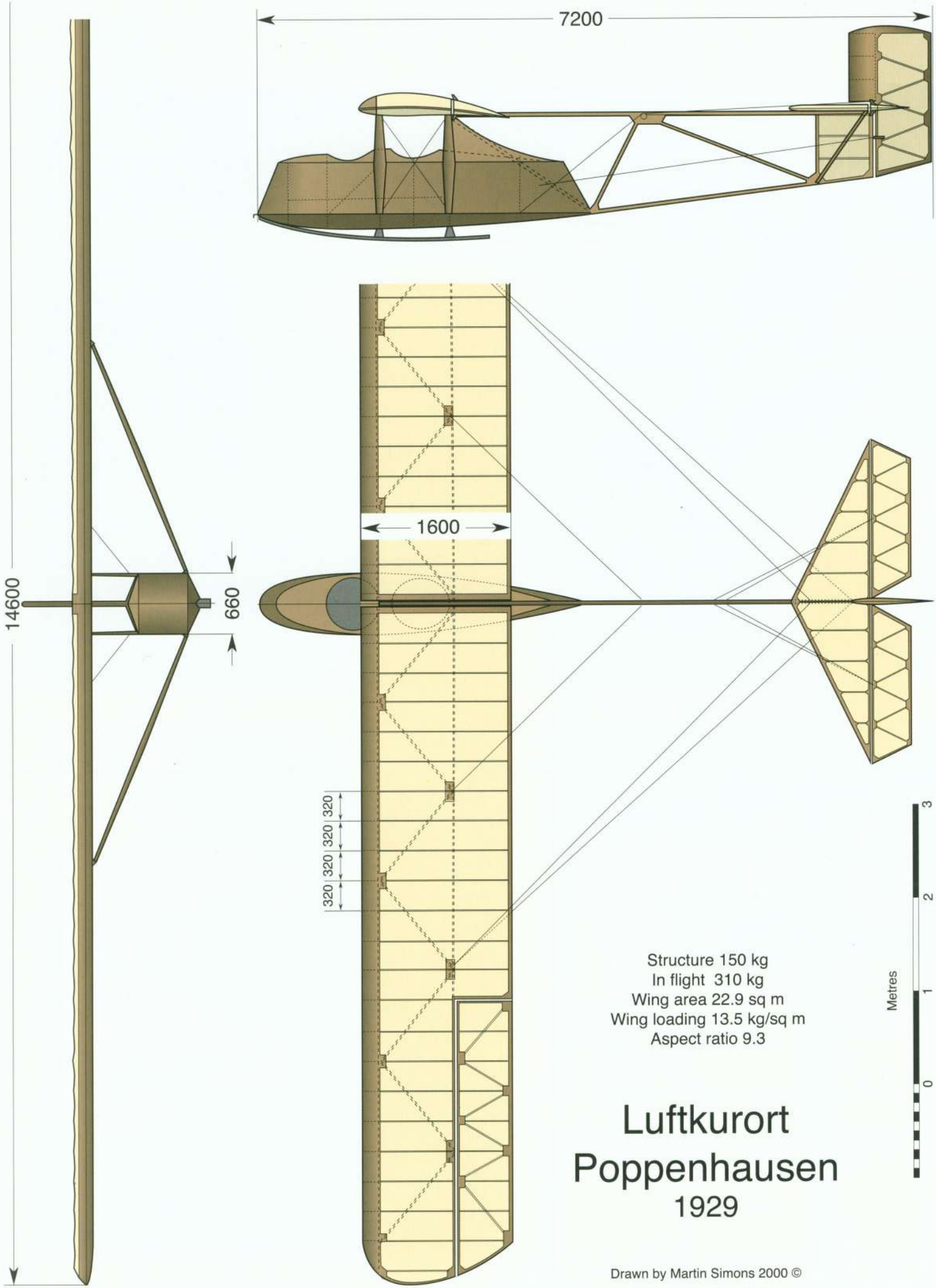
The Poppenhausen two seater, originally marked Luftkurort Poppenhausen a.d. Wasserkuppe was flown by Alexander Schleicher in 1928. He took passengers and gave them their first experiences of soaring flight. It was thereafter included in the Segelflugzeug Rhön factory catalogues alongside Schleicher's versions of the Hols der Teufel, Zögling, Falke, Professor and the Anfänger, a strut-braced primary glider. It is almost certain that Hans Jacobs was involved in the design.

The Poppenhausen, Alex Schleicher's two seat development of the Hols der Teufel, with dual controls.

The two seater, considerably modified for production, was in all respects an enlarged version of the Hols der Teufel. The seats were in tandem, enclosed by a nacelle. The best glide ratio was claimed as 16.4 and the minimum rate of sink at 0.88 m/sec. Schleicher showed it was capable of good soaring flights, carrying two persons. Fitted with dual controls, the Poppenhausen was described as suitable for advanced pupils in clubs. The price quoted in 1931, f.o.b. London, was $439 (US) dollars. The Zögling cost $227, the Anfänger $220. In other words, this two seater soaring sailplane cost twice as much as a primary solo glider. The argument that a pupil pilot could be trained 'ab initio' in such a two seater, at least twice as effectively as in the Zögling, does not seem to have occurred to anyone. How many were produced in total is not known but at least one was exported to England and flown by the London Gliding Club.

Rhönadler

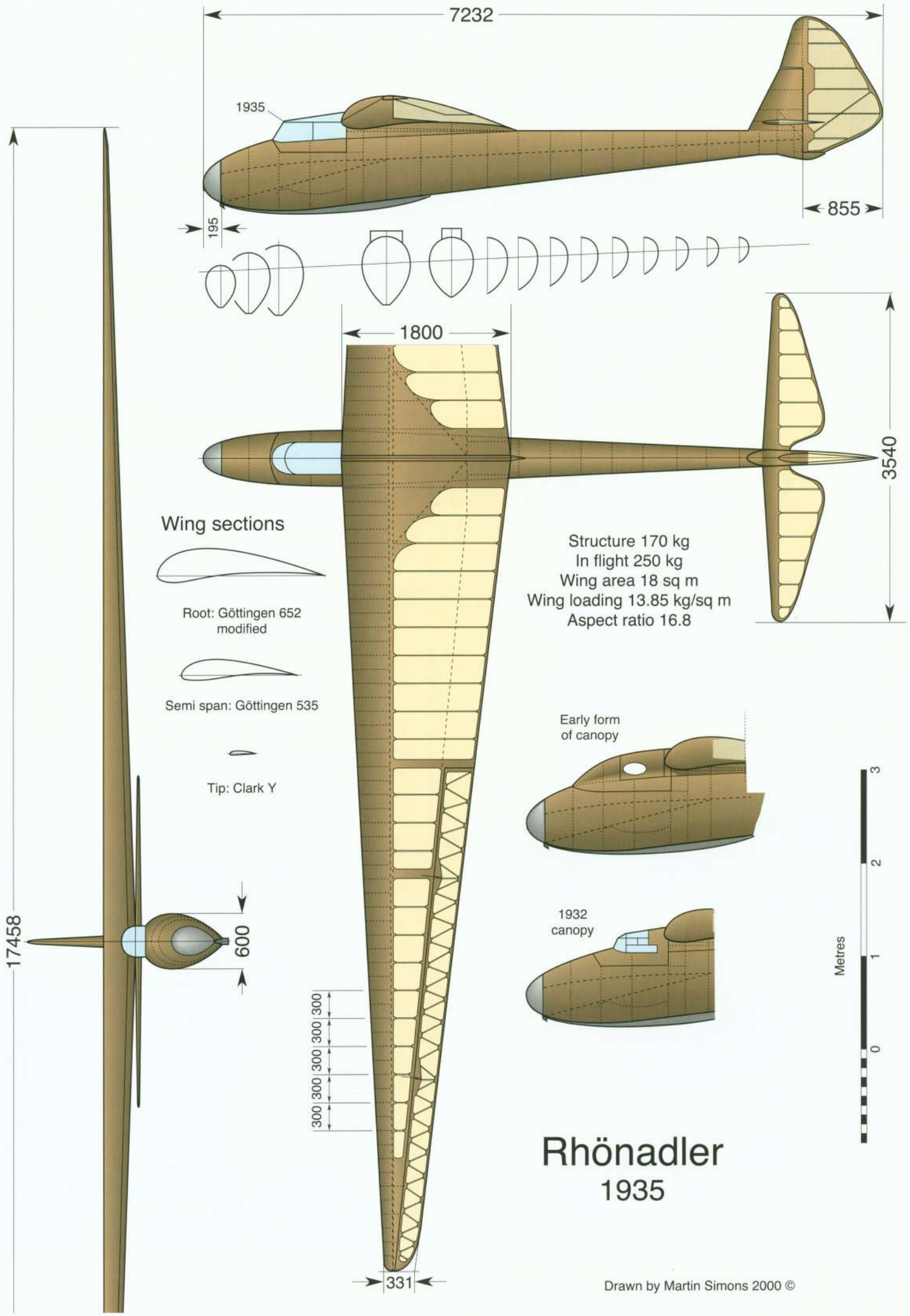
Schleicher recognised the growing demand for cross country sailplanes and admired the Fafnir. He commissioned Hans Jacobs to design a simplified version which would be suitable for factory production and not prohibitively expensive. The prototype, called Rhönadler, was ready for the 1932 Rhön. (There had been an earlier Rhönadler, a record breaking two seater.) The wing was raised above the streamlined fuselage on a narrow neck to try to avoid the flow separation problems that had beset the Fafnir at first. The wing was straight tapered to give ample spar depth at the root, and there was no gull bend for simplicity in production. The span was 18 metres. The root wing profile was a modified, less cambered version of the



Structure 150 kg
In flight 310 kg
Wing area 22.9 sq m
Wing loading 13.5 kg/sq m
Aspect ratio 9.3

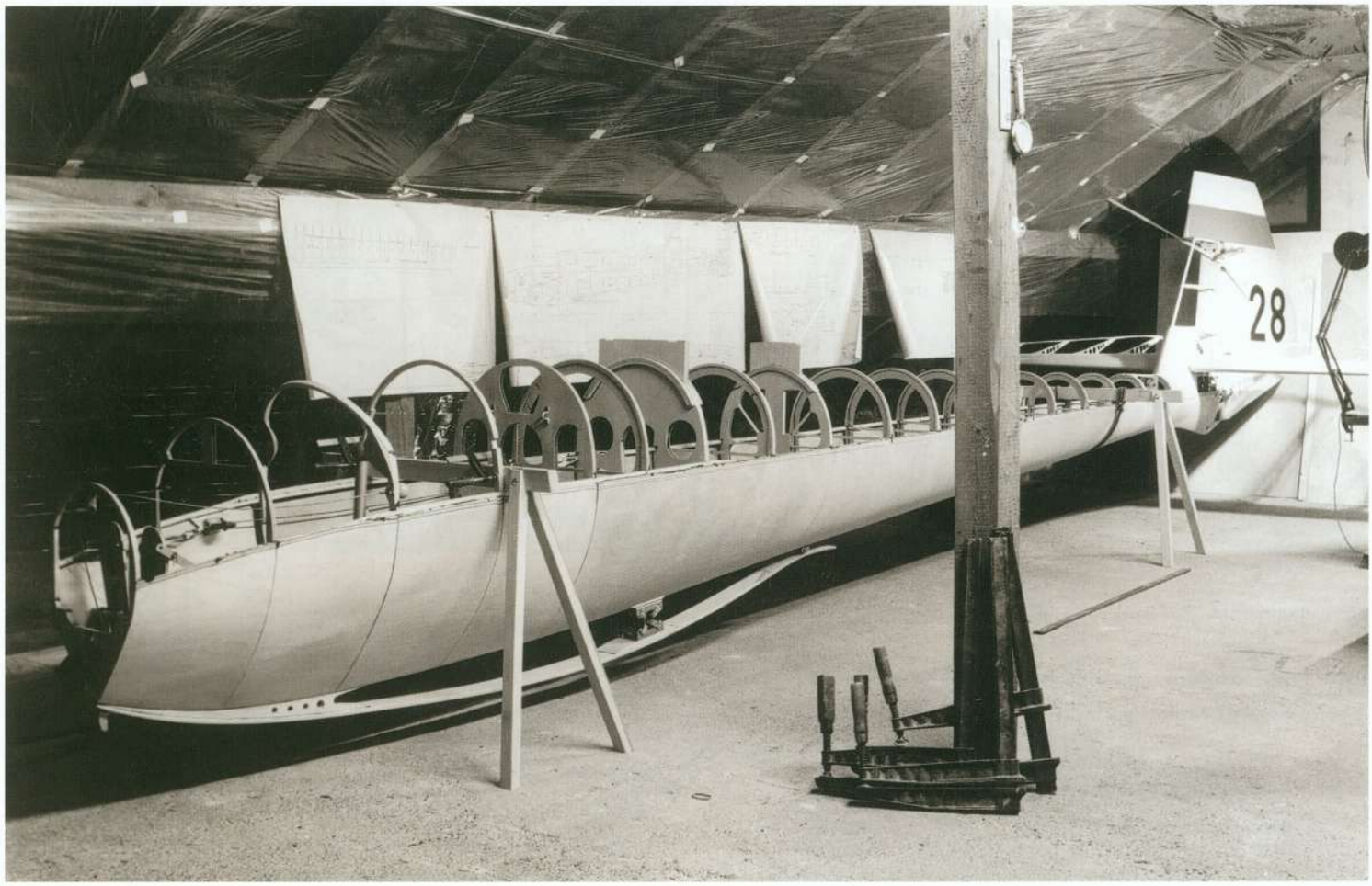
Metres 0 1 2 3

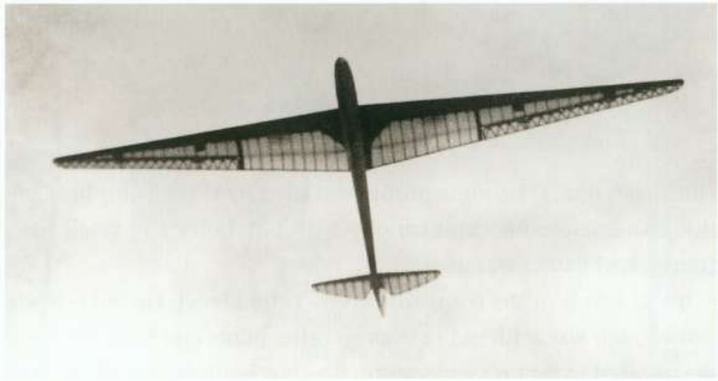
Luftkurort Poppenhausen
1929



Rhönadler
1935

Drawn by Martin Simons 2000 ©





Above: Klaus Heyn, using original plans for the Rhönadler 35, built a perfect replica during the 1980s, now in the Wasserkuppe Museum. Here is the fuselage partly completed, showing a typical 1935 sailplane structure.

Right below: The Rhönadler overhead, showing the strongly tapered wing.

Left: The original Rhönadler had a span of 18 metres. This was reduced for the production model.

Above: Rhönadler launched from the Wasserkuppe.

Below: The Seeadler was a version of the Rhönadler with a flying boat hull and strongly 'gulled' wings to keep them clear of the water. Hanna Reitsch was the test pilot.

Göttingen 652. (The same profile was used by Dittmar for his Condor.) An enclosed cockpit canopy with portholes and small inset transparent panels was used.

It was flown in the competitions by Peter Riedel. He did not win but enough was achieved to impress other pilots and Schleicher was encouraged to set up a production line. Recognising the difficulties caused by the Fafnir's low mounted tailplane, on the production version of the 'Adler this was re-positioned higher and the vertical tail simplified in shape. The span was reduced slightly. The Rhönadler 32 was advertised and sold well. In 1935 further changes of detail were made, including now a fully enclosed transparent canopy. The Rhönadler 35 became the most popular high performance sailplane in Germany. Schleicher built 65. At the 1935 Rhön meeting, 23 Rhönadlers competed in a total field of 60. Examples were exported, including one to England where it was flown by Eric Collins, the leading British pilot of the day. Spoilers were often fitted, retrospectively, on the upper side of the wing.

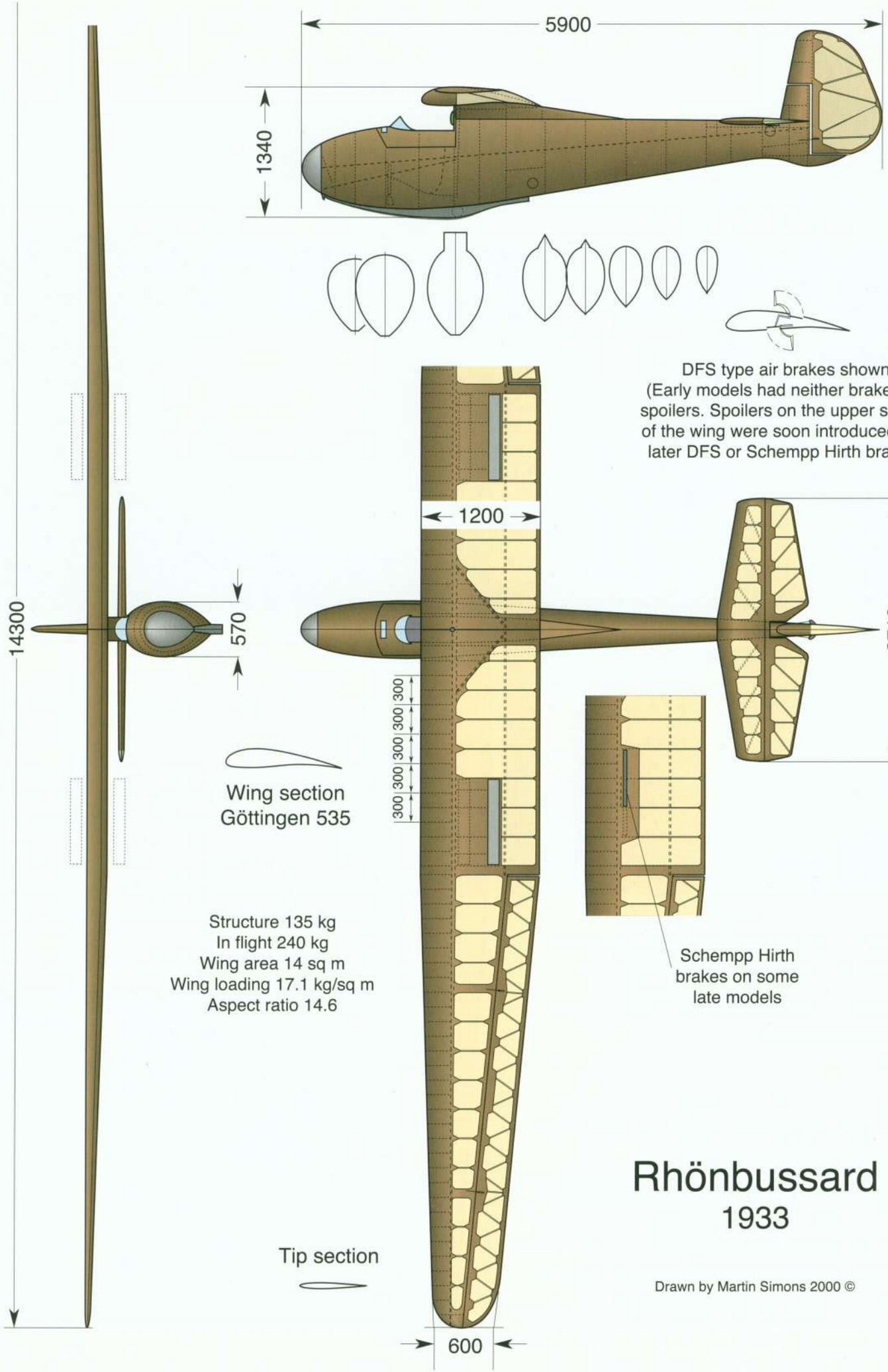
Klaus Heyn in the 1980's completed a new Rhönadler 35 from a set of the original plans. This aircraft is now in the Wasserkuppe Museum.

Rhönbussard

Many gliding instructors felt the Rhönadler was too advanced for inexperienced pilots. They required something better than the Grunau Baby but smaller and cheaper than the 'Adler. Schleicher asked Jacobs to design a sailplane to fit this requirement. The outcome in 1933 was the Rhönbussard. This had a span of 14.3 metres, a streamlined if rather dumpy fuselage, and a cantilever wing, ensuring a better performance than the Baby. The short fuselage required the pilot's seat to be under the wing for reasons of balance. This restricted the upward view, especially important in banked turns. Despite this the type proved successful. Over 200 were built. At the 1934 Rhön, sixteen Bussards competed, outnumbered only by the Grunau Baby.

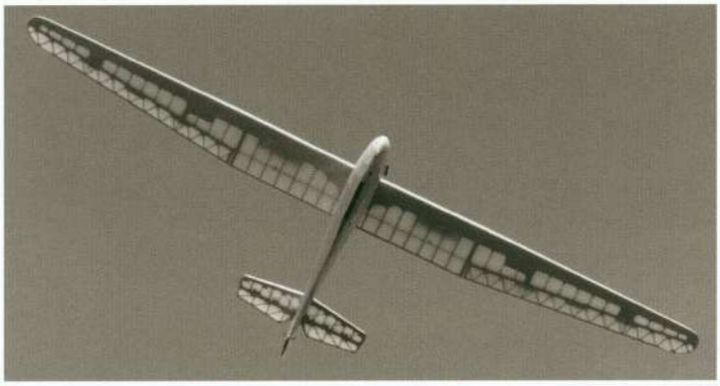
The most unusual feature was that when rigging the wing was joined in the centre before raising the entire assembly onto the fuselage, to which it was held by two crosswise steel rods. The lifting was not difficult providing enough people were available. The early models had no spoilers but these were incorporated later, of-

A small number of Bussards were equipped with Schempp Hirth type air brakes. This example was flown by the British Air Force of Occupation at Scharfoldendorf in 1948 - 50.



Structure 135 kg
In flight 240 kg
Wing area 14 sq m
Wing loading 17.1 kg/sq m
Aspect ratio 14.6

Rhönbussard
1933



Above: The Rhönbussard. This example, imported to England in 1934, was flown in aerobatic displays by Joan Meakin for Alan Cobham's Air Circus

Middle: Overhead, this restored Bussard has only spoilers on the upper side of the wing. Later versions had DFS type brakes.

ten by retrospective modification. When brakes were added, they were usually of the DFS type but some late production examples had the more effective Schempp - Hirth brakes.

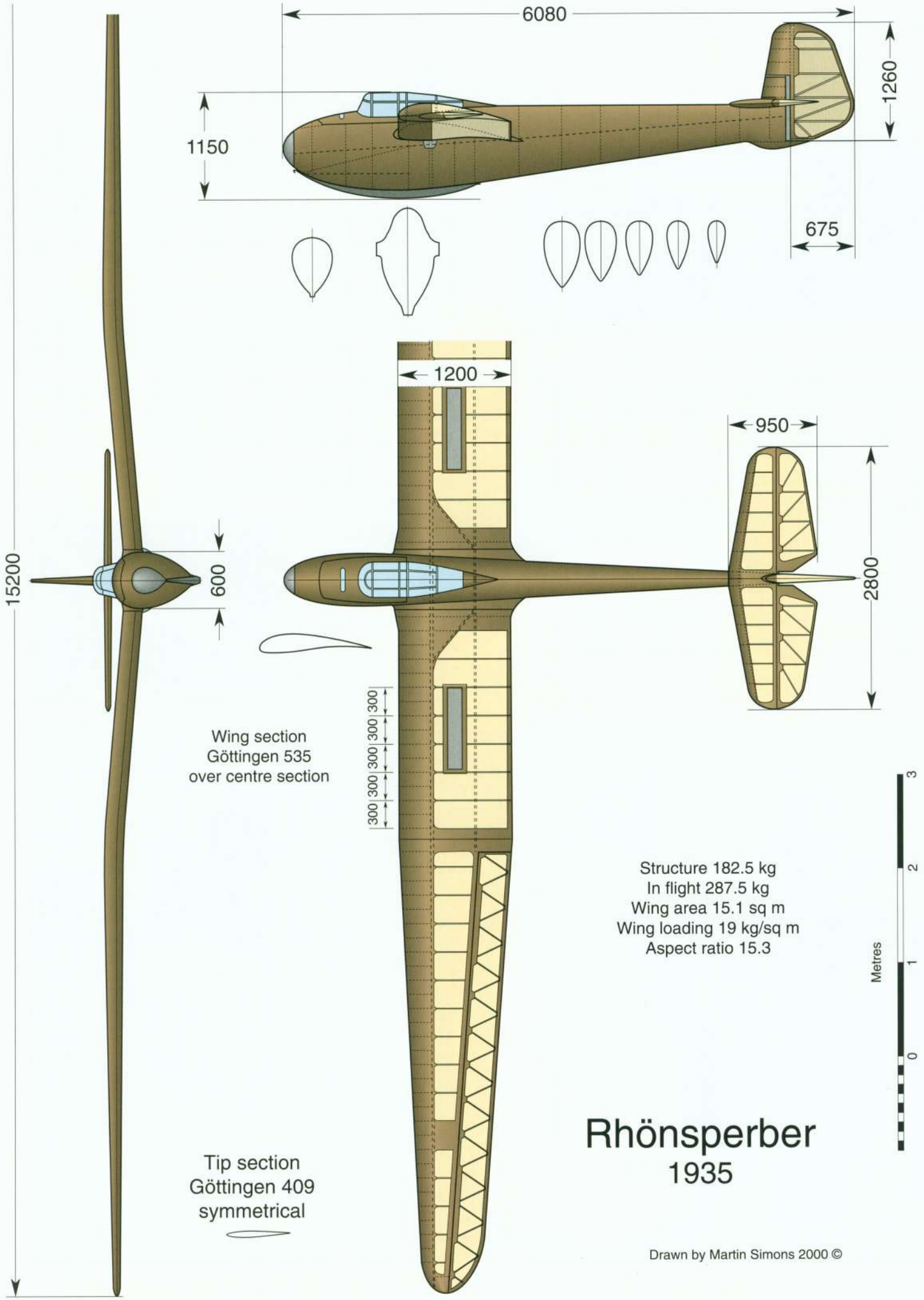
Many good flights were done in Rhönbussards, including aerobatic displays. It was strong and highly manoeuvrable. A world height record should have gone to Hermann Seele in 1936 when he reached more than 5000 metres in cloud. Unfortunately, in hail and severe turbulence he lost control. The Bussard broke up. He was saved by parachute but the recording barograph was lost.

At least one Rhönbussard survives in airworthy condition.

Rhönsperber

Jacobs developed the Rhönbussard to produce the Rhönsperber in 1935. This entered production with Flugzeugbau Schweyer, who built about one hundred. The wing, with gull dihedral, was moved down to shoulder height with an increase in span. This greatly improved the pilot's view into turns. There was an enclosed, streamlined transparent canopy but in many other ways the 'Sperber was simply an enlarged Bussard, with a better performance chiefly because of the greater span, now slightly over fifteen metres. The type became popular and was used for some outstanding cross country flights, especially notable being Ludwig Hofmann's 1935 world

Ernst Udet's Rhönsperber, D - Commandant, carried the Olympic rings in 1935 - 6.



Rhönsperber
1935

record, 474 km into Czechoslovakia. This was the first soaring flight to exceed 400 km but the record lasted only a week. A 'Sperber flown by Hans Heinemann was one of the four which exceed 500 km. on July 29th with 504 km.

Ernst Udet, the famous display pilot who later was to become a chief officer in the Luftwaffe, flew his own personal Rhönsperber, marked D - Kommandant, from the Jungfrau in 1935. Peter Riedel used one for aerobatic displays at the Winter Olympic Games at Garmisch in 1936, taking off and landing on the ice.

Rhönsperbers were exported to the USA and England. The English example was restored and rebuilt to fully airworthy condition after decades of neglect. It flies today with a Rhönbussard tailplane. The original tail was lost. The Bussard tailplane fitted exactly without modification. Another perfect replica has been built and flown in Germany by Otto Grau in 1997. Others survive in museums.

Sperber Senior

In 1936 Jacobs designed an improved and enlarged version of the Rhönsperber, the Sperber Senior. Despite the name this was really a new design with a different, double tapered wing of greater span, less cambered aerofoil sections and entirely new fuselage and tail unit. Only one was built. Hofmann flew it in the 1936 competition but was forced to withdraw for family reasons and did not figure in the final results.

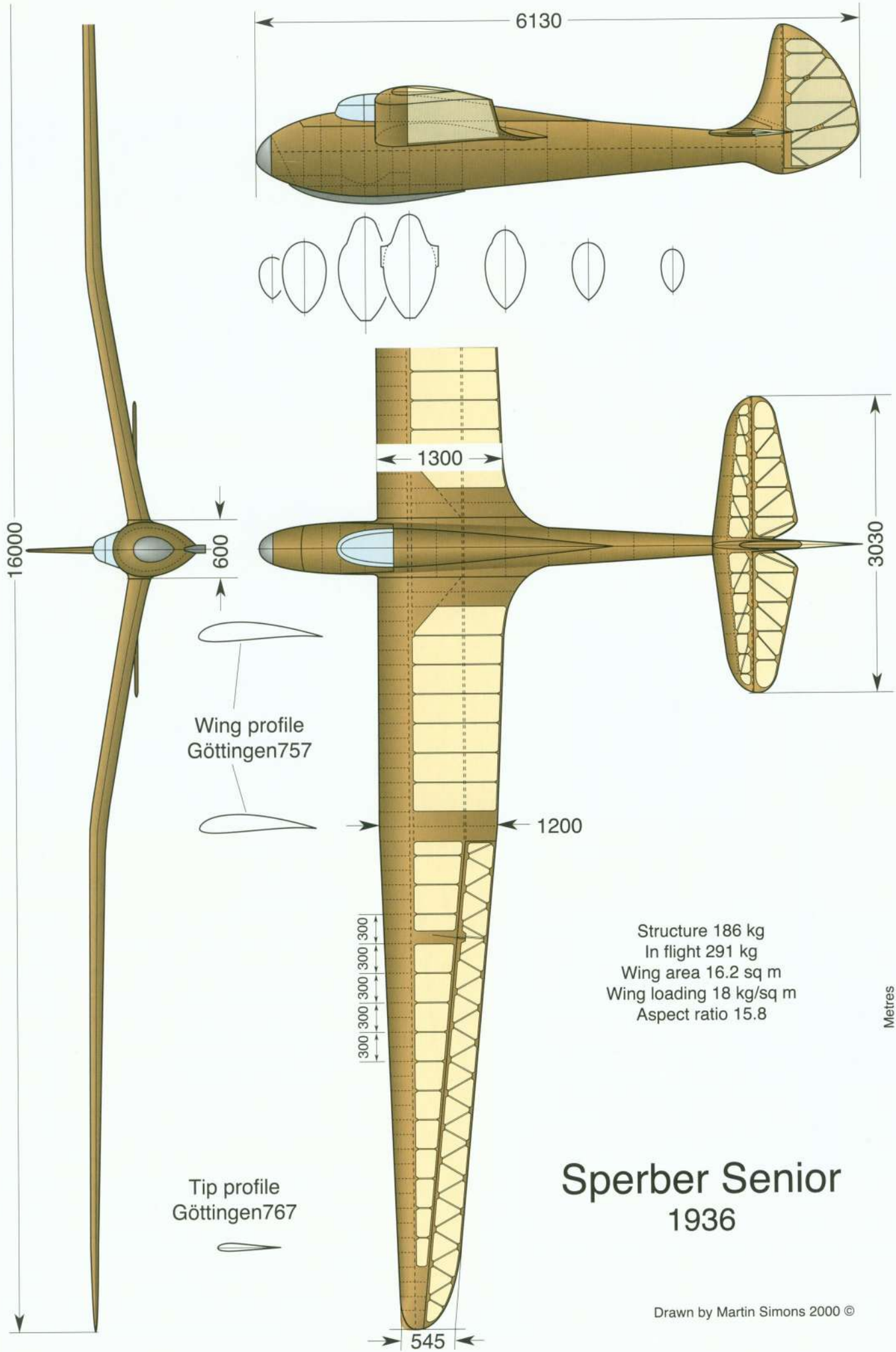
The Sperber Senior became available in 1937 for Peter Riedel to fly in the American National Competitions at Elmira and it was shipped there for him. He made a seven hour soaring flight in thermals over central New York City, including Manhattan and New Jersey, after an aero towed launch from Roosevelt Field on Long Island. In the contest he scored higher than any American pilot but, as a German national, could not be declared champion.

On its return to Germany the Sperber Senior was apparently withdrawn from use and its fate is unknown.

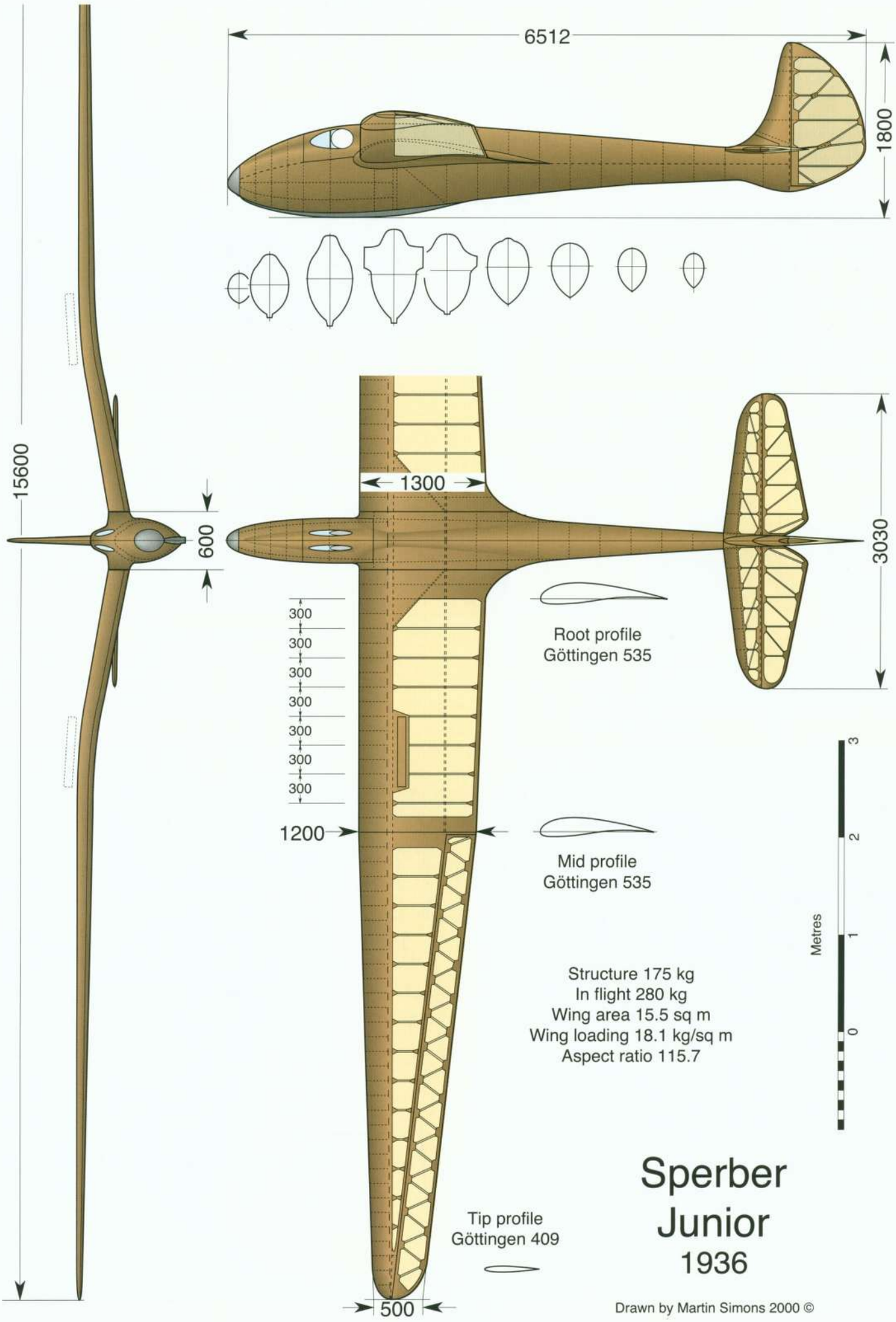
Left above: D - Urubu was displayed at the 1936 ISTUS meeting

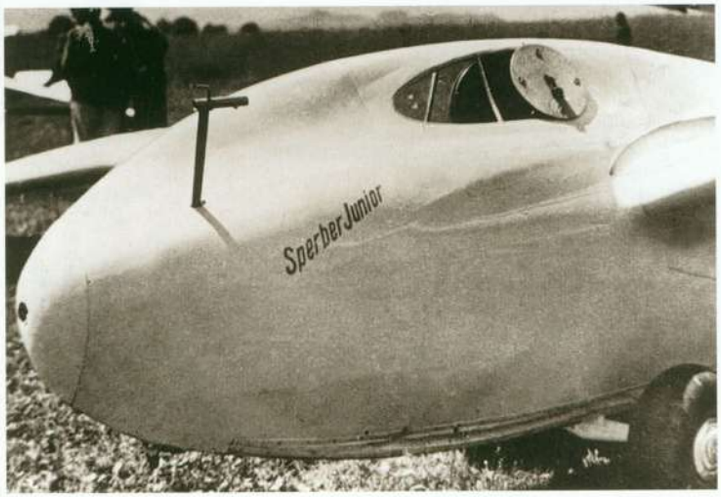
Right: Riedel soared the Sperber Senior over central New York.

Below: The Sperber Senior, Riedel with parachute preparing to board.



Sperber Senior
1936


6512
1800
15600
600
1300
3030
300
300
300
300
300
300
300
1200
500
Root profile
Göttingen 535
Mid profile
Göttingen 535
Tip profile
Göttingen 409
Structure 175 kg
In flight 280 kg
Wing area 15.5 sq m
Wing loading 18.1 kg/sq m
Aspect ratio 115.7
Metres
0
1
2
3
Sperber
Junior
1936
Drawn by Martin Simons 2000 ©



Left above: For drag reduction the cockpit canopy reverted to the old Fafnir type, but with transparent plastic covering part of the portholes.

Right above: For Hanna Reitsch, Jacobs designed the Sperber Junior, the cockpit just big enough for her. No one else could fit into it.

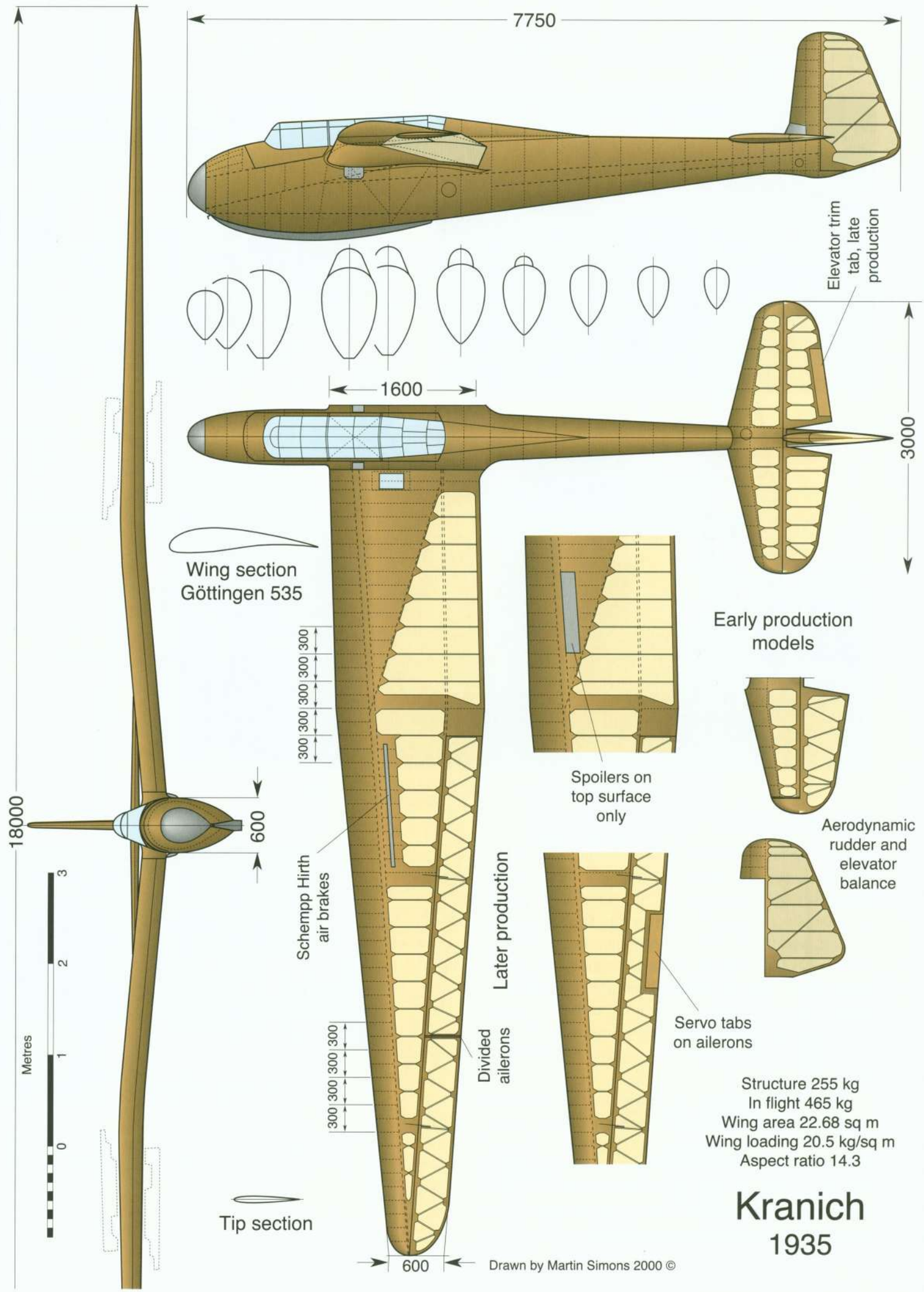
Left: In side view, the shape was perfect.

Sperber Junior

The Sperber Junior, probably one of the most beautiful sailplanes ever flown, was built specially for Hanna Reitsch. The fuselage was designed around her small frame. She herself found it a tight fit and no other pilot could get into the cockpit. The wing in plan, and the tail unit, were like the Sperber Senior but the aerofoil sections were the same as the standard 'Sperber. The gull wing form was much more pronounced. The cockpit canopy was similar to that of the original Fafnir with portholes partly enclosed with transparent plastic, carefully faired to the fuselage and wing root. The Sperber Junior was painted in a spectacular blue and cream 'sunburst' pattern on the upper surfaces.

After a fierce quarrel with the rule makers who, following political guide lines, attempted to exclude women, Hanna entered the 1936 Rhön contest and placed fifth in the final tally. In May 1937 she was one of five pilots who crossed the Alps in soaring flight, to land in Italy 415 km from her take off in Salzburg. After this she became involved in military flight testing work and the Sperber Junior was neglected. All trace of it was lost during the Second World War.

The airbrakes came just at the curve of the gull wing and had to be shaped to close neatly. A vivid blue and white sunburst colour scheme was used on the upper surfaces.


7750
Elevator trim tab, late production
1600
3000
18000
600
Wing section Göttingen 535
300 300 300 300 300
Schempp Hirth air brakes
Early production models
Spoilers on top surface only
Aerodynamic rudder and elevator balance
Later production
Servo tabs on ailerons
Divided ailerons
300 300 300 300 300
Tip section
600
Metres
0 1 2 3
Structure 255 kg
In flight 465 kg
Wing area 22.68 sq m
Wing loading 20.5 kg/sq m
Aspect ratio 14.3
Kranich
1935
Drawn by Martin Simons 2000 ©

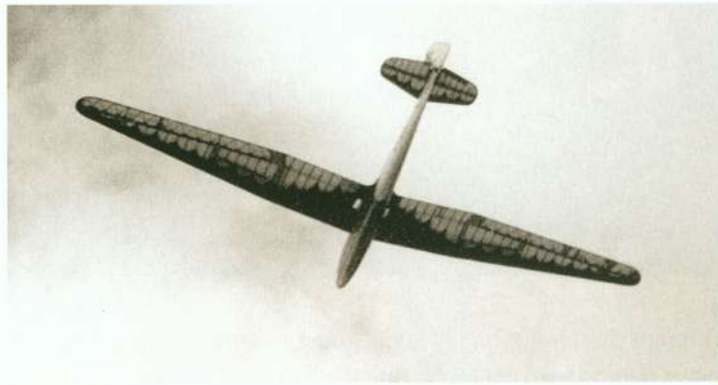
Right: The rear pilot of the Kranich sat between the wings, the main spar crossing the fuselage in front.

Middle right: The Kranich, Hans Jacobs' famous two seater.

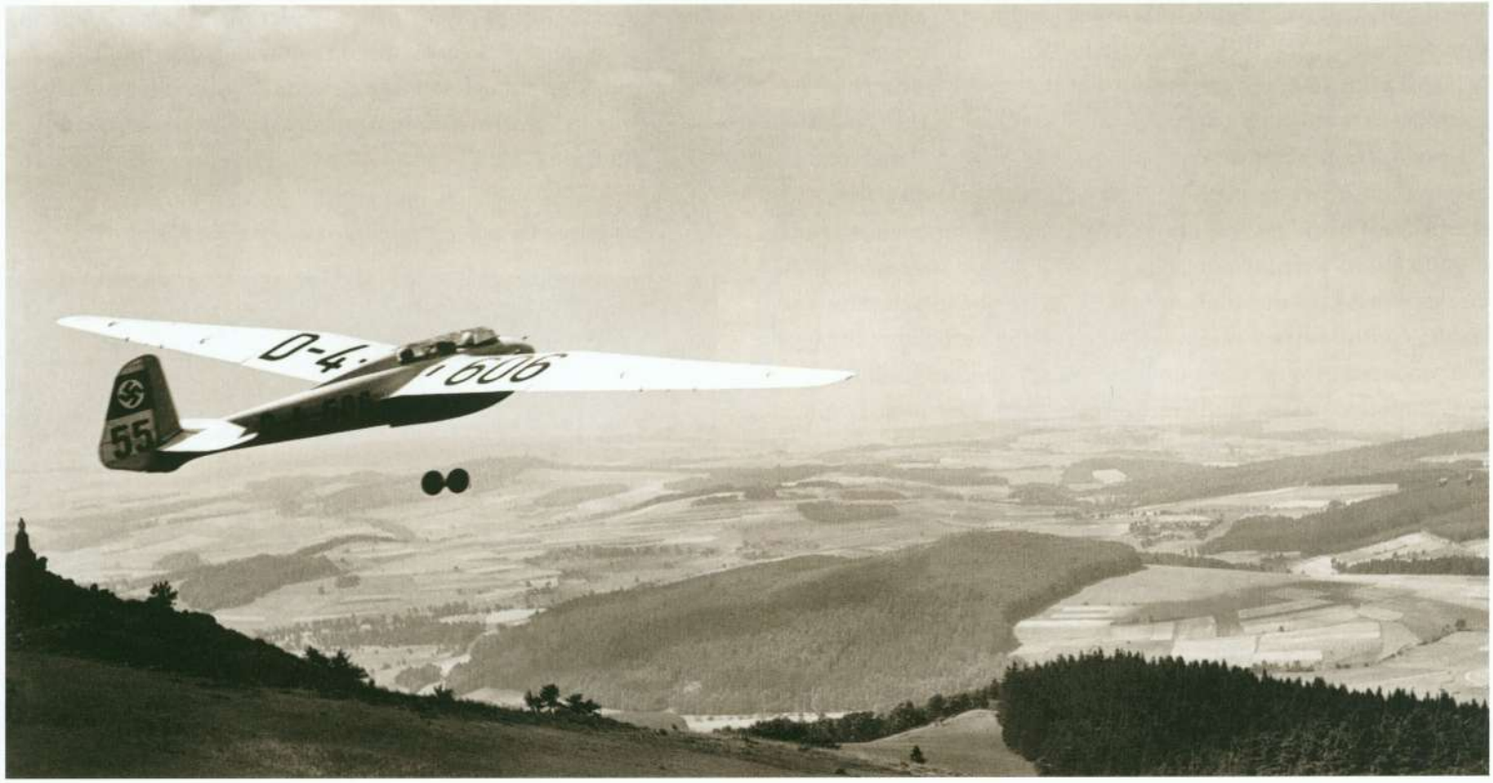
Below: The two wheeled dolly was dropped after take off.

Kranich

The need for some high performance two seat sailplanes prompted Hans Jacobs to design what was at first described as a two seat Rhönsperber. This became the Kranich. It was in most respects an enlarged 'Sperber with similar aerodynamic layout but, necessarily, larger wing area and a span of eighteen metres. The seats were in tandem to keep the fuselage cross sectional area as small as possible. To achieve satisfactory balance the wing was slightly swept back so that the rear seat was close to the centre of gravity. The Kranich could then be flown safely solo from the front seat. The prototype flew with open cockpits but in production a long, enclosed, transparent canopy was fitted.



With the wing mounted at shoulder level, and the slight gull wing, the rear pilot had vision seriously restricted. In front, seen



Left: The Kranich at Elmira in 1938. Two competed in the American Nationals on this occasion.

Left below: Kranichs were flown by the British Air Force of Occupation in Germany after World War 2.

through the long canopy which formed a sort of tunnel, was the other pilot's head. On either side the gull wing rose up to limit the lateral outlook. Only upwards and backwards was there a clear view. Two transparent panels were let into the wing root to allow some vision downwards, but these were very inadequate. Instructors in the rear seat often removed the rear part of the canopy entirely, allowing them to see directly ahead by leaning sideways in the cockpit.

Despite these disadvantages the Kranich had a better performance than any comparable two seat sailplane and broke almost all the two seat world records at some time. Many improvements and modifications were introduced, such as air brakes instead of spoilers, servo tabs on the ailerons and variations of the elevator and rudder control surface balances. Taking all marks together the type was produced in very large numbers. Available records indicate that one contractor alone built more than 1300. The total is much greater since Kranichs became involved in expanded pilot training schemes for the Luftwaffe and were built in factories in various German occupied countries during World War 2, and a few afterwards.

A modified Kranich was used for experiments with a prone pilot. The front fuselage was completely redesigned to take a pilot lying face down. Kranichs were also involved in some desperate efforts to re-supply troops isolated by advancing Russian armies on the eastern front during 1944 - 5. After the war, there was further, limited production in Spain and Czechoslovakia.

Several survive in flying condition, and others are preserved.

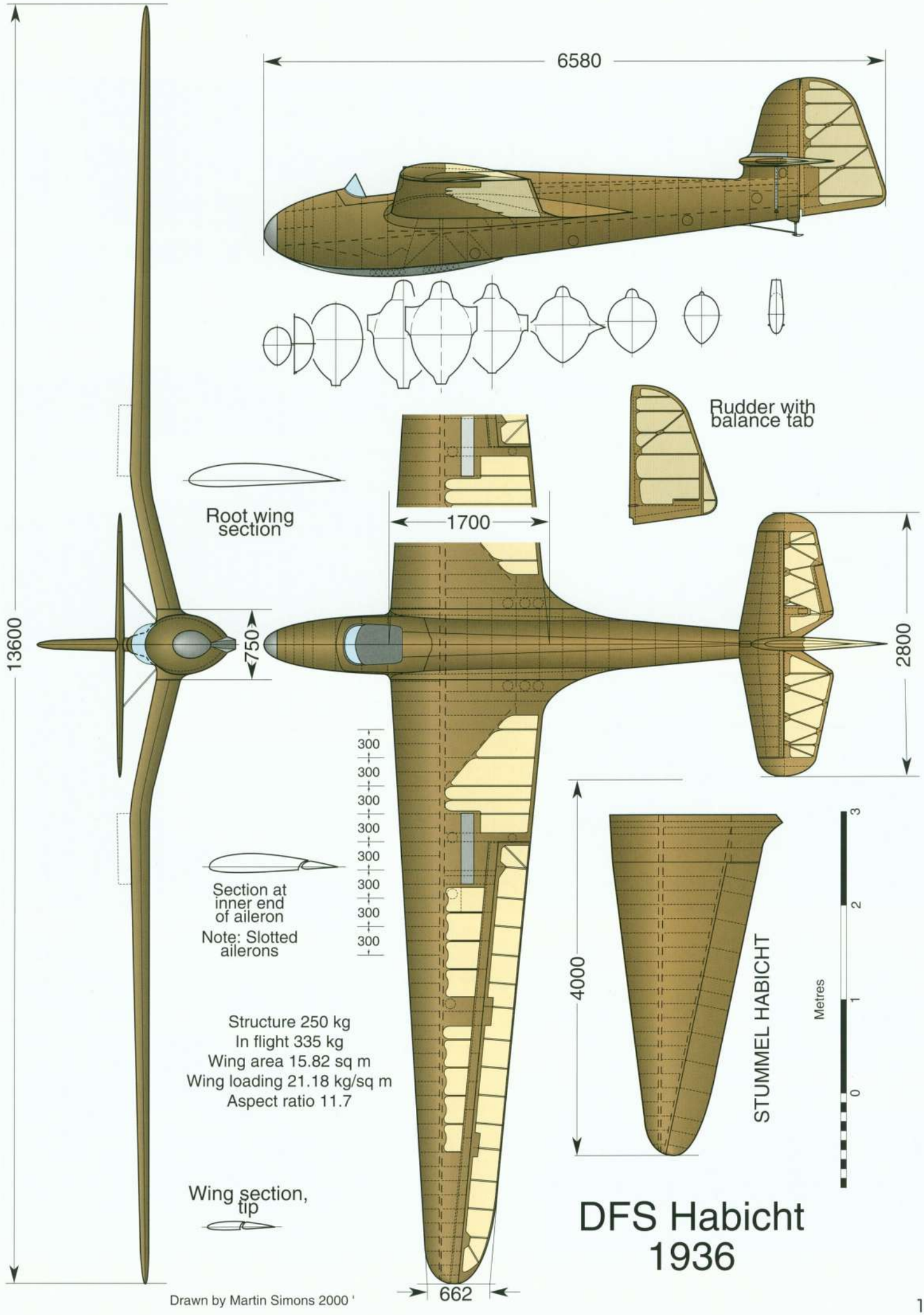
Habicht

Aerobatics in gliders are, inevitably, wasteful of energy since every manoeuvre sacrifices altitude. Pilots who have worked hard to gain height by soaring, do not often want to throw it all away. Occasionally at the end of a successful flight which leaves them with some height to spare, they might perform a few loops, stall turns or other simple high spirited stunts. For most, that is enough.

There has always been, however, some interest in glider aerobatics at air shows and it is often argued that every pilot should learn how to retain control in unusual attitudes, so all should master the necessary skills.

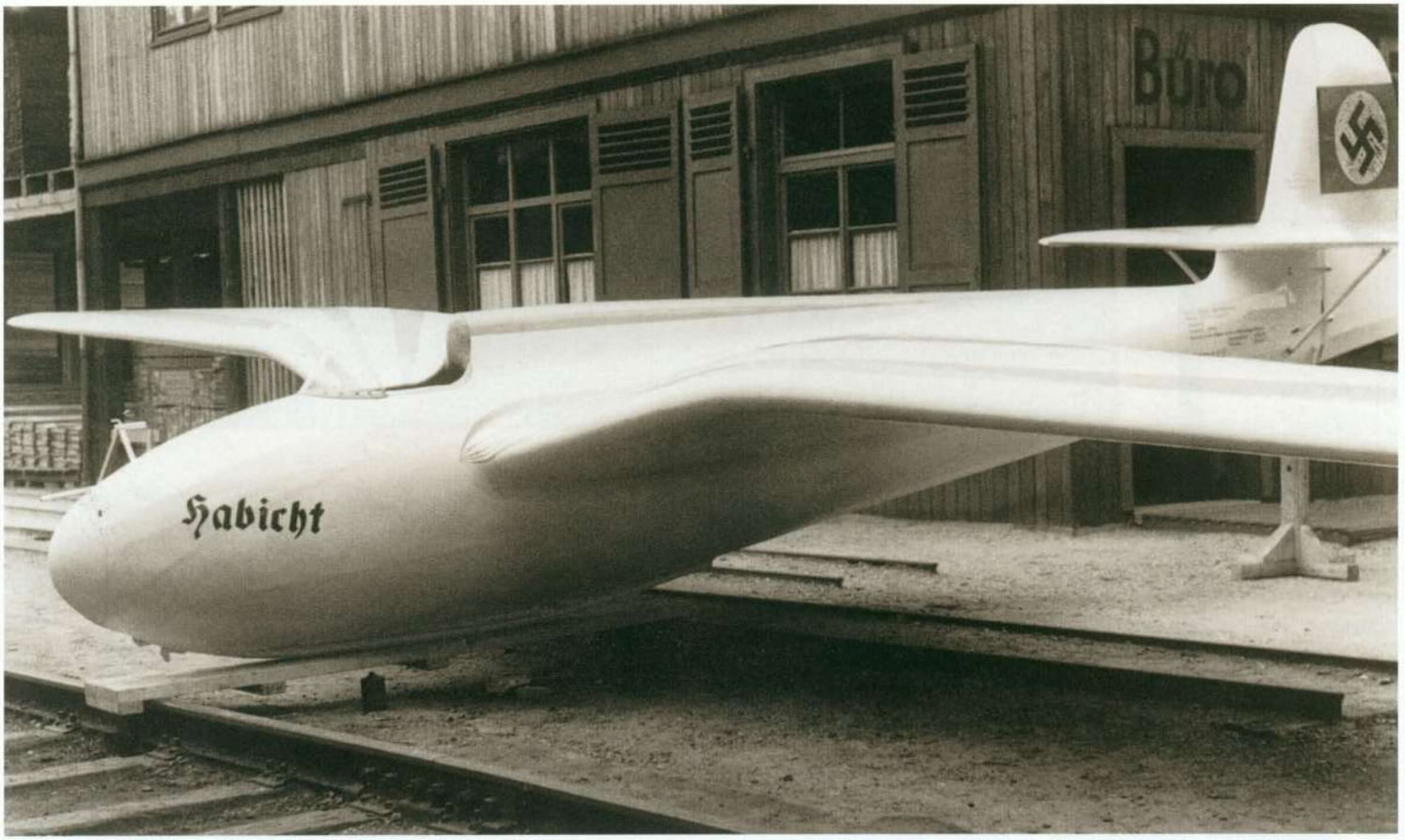
Hans Jacobs designed the Habicht as a fully aerobatic sailplane for the air displays planned in connection with the 1936 Olympic Games in Berlin. It had to be capable of all possible manoeuvres, including inverted flight, slow rolls and flick rolls. It would also need a good gliding performance. Apart from use as a soaring sailplane, it must pick up airspeed rapidly in a dive and conserve this energy long enough to make a reasonably extended display before having to land. An aerodynamically crude glider would not be capable of this.

The Habicht showing the usual blue and cream sunburst colour scheme.



DFS Habicht 1936

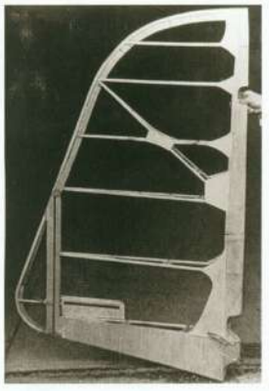
Drawn by Martin Simons 2000 '



Above: An early Habicht built by Schweyer. Note the small vertical tail surfaces.

Left: The Habicht was designed for aerobatics. D - 8002 is the new Habicht built from the old plans, flown in 1995 at the Wasserkuppe and Oberschleissheim.

Right: Detail of the Habicht rudder with balance tab to reduce the pilot's loads.



The DFS carried out many calculations and performed special tests on the main structural components of the proposed design. These were fully reported in the academic press. The wing, only 13.6 metres span for the sake of rapid rolling ability, was stressed for a normal load factor of 12 g. The plywood skin on the leading edge was 1.5 mm thick laid with the grain running diagonally for increased torsional stiffness. The ailerons were slotted to improve their effectiveness.

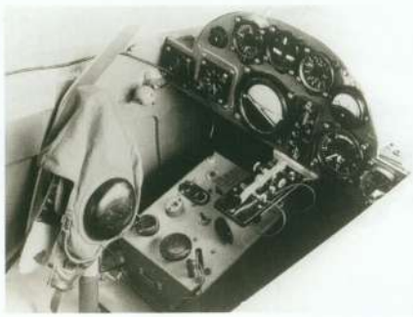
The prototype had an enclosed canopy but the open cockpit with windscreen was preferred, allowing the pilot to feel the airflow directly as an aid to accuracy in flight. Early tests proved the Habicht capable of all that was required. Four were ready in time for the Olympics and were flown over the stadium in Berlin, and even down into it, diving below the level of the spectator stands, pulling up and flying away to land outside the arena. The pilots were Hanna Reitsch, Ludwig Hofmann, Otto Brautigam and Heinz Huth (the same who became World Champion soaring pilot in 1960). The sailplanes were painted on their upper surfaces with the 'sunburst' scheme in blue and cream like that used for Hanna's Sperber Junior.

Small scale production of the Habicht was undertaken and the type was used widely for advanced pilot training and displays. Hanna Reitsch flew one at the Cleveland Air Race displays in the USA, in 1938. A larger rudder was found desirable and most of the aircraft had this after the first few were completed.

Jacobs and his team had not imagined that even more extreme versions of the Habicht would be demanded. These were to be used for training glider pilots to fly the extremely fast, and highly dan-

gerous, Messerschmitt Me 163 rocket propelled fighter which Lippisch, after departing from the DFS, had developed. The Stummel Habicht was produced in two sizes, 8 metres and 6 metres span. These stalled at about 75 to 80 kph and were said to handle somewhat like the Me 163. The work for this programme was contracted out from the DFS. The Wolf Hirth factory at Kirchheim built 35 of the Stummel Habicht and others were built elsewhere.

Pilots who had flown the Grunau Baby were selected, taught to fly the Habicht, then the Stummel Habicht. A few gliding flights in the Me 163 without fuel, towed up by a Messerschmitt 110, followed. The young men were then sent into action against the American bombing forces. If the engine did not blow up they would reach 35 to 40,000 ft in a matter of three or four minutes and were expected to open fire on the bombers. A very few managed to do so, but not many then survived the subsequent gliding descent and landing on a skid at a speed of about 260 kph. Hirth also experimented with Habichts fitted with machine guns and bombs. These were intended for training only.



Left: The instruments, including a radio, in the Reiher cockpit for the expedition to North Afrika.

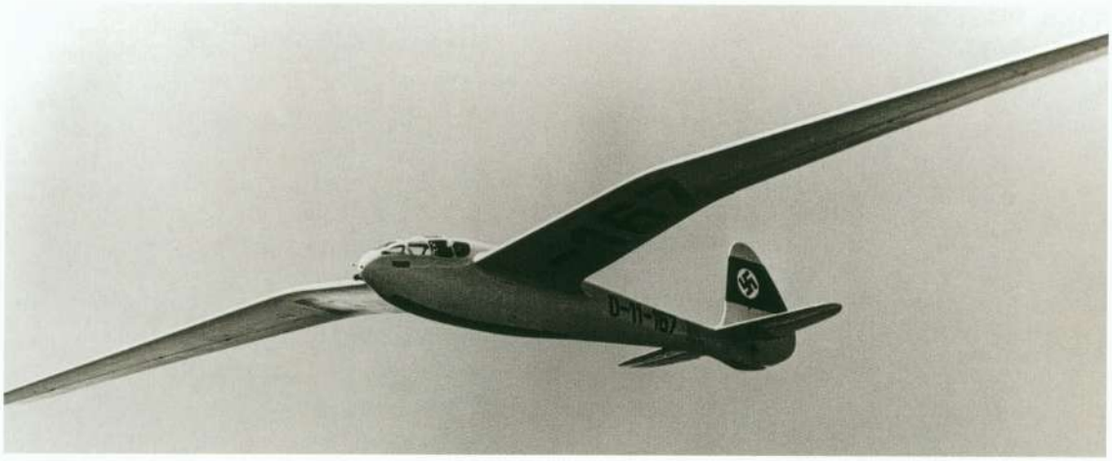
Below: The Reiher prototype was flown by Hanna Reitsch in the internationals of 1937.

One Habicht survived the war and was preserved in a Paris museum. A completely new Habicht, the 13.6 metre span version, has been built by the Old Timer Group at the Wasserkuppe, and flown. It is now preserved in the Wasserkuppe Museum.

Reiher

By 1936 the practice of cross country soaring in thermals had become better understood. The leading pilots knew now that the mere ability to drift along in a downwind direction, using every thermal to extract the smallest gain of height, was not good enough. To achieve the greatest distance, in the limited hours of thermal activity, demanded a high average speed. The pilot must not waste time in weak lift but should straighten out on course when the variometer began to show reduced rates of climb. Between thermals, sinking air must be penetrated as quickly as possible. What was required was a sailplane which would climb well enough, but which would also fly fast without sacrificing too much height. In the past, designers had tended to concentrate everything on climbing ability, saving weight, using strongly cambered and thick wing profiles, aiming always for a minimal rate of sink. Now it was apparent that heavier wing loadings could be tolerated, providing the high speed glide was improved. The pilot with a faster, heavier sailplane would then be able to search more widely for strong thermals. The penalty of not being able to use the weak ones, was acceptable.

After some ten years of experience designing sailplanes, Hans Jacobs doubtless felt the time had come to bring everything to-



Left: D-11-167 was a Reiher II off the production line.

Below: A rare photograph showing five of the production Reihers together.

gether to produce a masterpiece. All the resources of the DFS were called upon. Wind tunnel tests established that the most promising wing profile for the new sailplane was the Göttingen 549. This had been used before on Kronfeld's Wien, so it had a good record in practice. The emphasis on high speed gliding as well as low sinking speed required every possible aerodynamic refinement. The wing must have a high aspect ratio even at the cost of added weight. To vary the wing camber in flight would be useful, so there should be flaps. The wing spars were to be built of selected spruce, rather than the slightly heavier pine on which most German designers had previously relied. Airbrakes now were a recognised necessity. The fuselage must be as perfectly streamlined as possible. Jacobs did not believe, however, that elaborate calculations and highly complex forms, such as Lippisch had used for the Fafnir 2, yielded any real advantage. A mid wing mounting with simple fairings would be best. The cockpit must be fully enclosed with a contoured, transparent canopy. Plastics were only just becoming known. The Reiher had twelve small panels moulded over curved forms, held in place by a built up plywood frame to give a very nearly perfect smooth shape. Gaps, protrusions and other items causing parasitic drag were eliminated as far as possible.

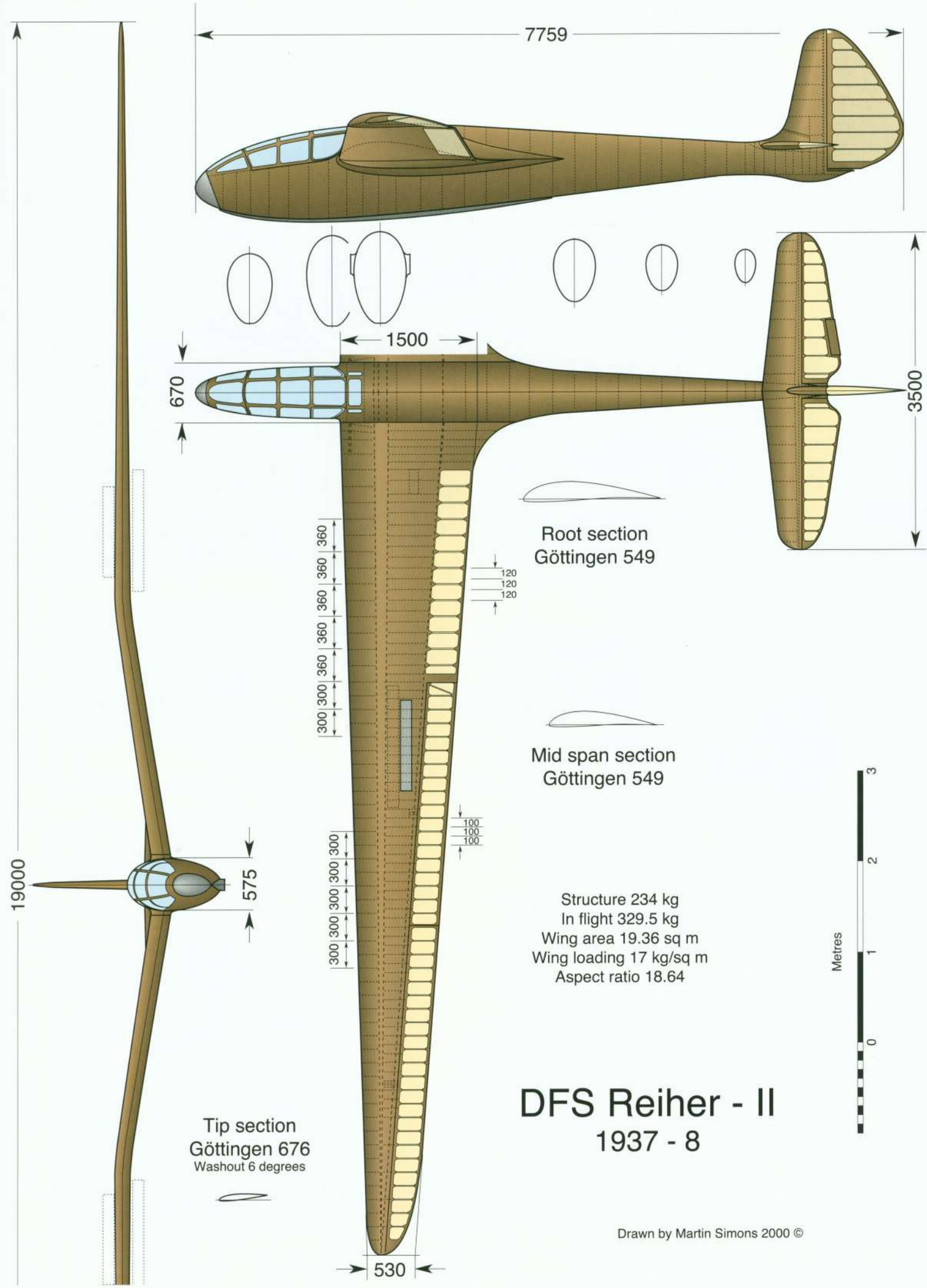
The Reiher prototype, 19 metres in span and by the standards of the time, heavy, was finished in time for the 1937 International Championships, in which it was flown by Hanna Reitsch. She had unexpected difficulties with it. The ailerons were heavy at high speeds and in rough air would sometimes snatch the stick out of her hand. The flaps did not seem to do much good. The air brakes had strange characteristics causing some heavy landings. Although there was no suggestion the wings could break, they did bend alarmingly when under load in steep turns. Despite all this Hanna set a new feminine distance record of 351 km and placed sixth, beaten by older and less refined sailplanes including the humble Mü 13 of Kurt Schmidt and the little Moswey of the Swiss, Sandmeier.

In reviewing the design, Jacobs decided that the wing should be stiffer, which could be achieved by using a more pronounced taper. The flaps were eliminated, the air brakes redesigned, the ailerons

mass balanced. The fuselage was reshaped to an even better streamlined form and the vertical tail was enlarged. The resulting Reiher Mark 2 was a great improvement and was put into limited production. Further detailed improvements resulted in the Reiher 3. It was the best sailplane ever to be made available from a factory.

In 1938 Wolfgang Späte, who was the first pilot to apply mathematical reasoning to the problem of sailplane cross country speeds, used the prototype Reiher, with structural stiffening and hence, more than 90 kg additional weight, to win the Rhön championships. His theoretical work was vindicated. In 1939 Erwin Kraft won the championships with the Reiher 3.

No Reiher survived the Second World War although it is said one was taken to England for examination at Farnborough. Apparently nothing was ever done with it and it was eventually scrapped there. In recent years, a new Reiher has been built by the Wasserkuppe Old Timers Group. Calculation and redrafting to replace lost drawings had to be done, but the finished aircraft is as perfect a replica as it is possible to build.



Root section
Göttingen 549

Mid span section
Göttingen 549

Tip section
Göttingen 676
Washout 6 degrees

Structure 234 kg
In flight 329.5 kg
Wing area 19.36 sq m
Wing loading 17 kg/sq m
Aspect ratio 18.64

Metres
0
1
2
3

DFS Reiher - II
1937 - 8

Weihe

Jacobs recognised that the Reiher was far too costly for general use but pilots everywhere now needed superior sailplanes for cross country distance and goal flights. Without compromising the performance too much, an 18 metre span sailplane with a greatly simplified structure would satisfy the demand. The Gö 549 profile was used at the root, slightly increased in thickness. Jacobs considered that a mid wing mounting, with necessary heavy frames to carry spar bending loads through the fuselage, as on the Reiher and his earlier Rhönsperbers, added structural complication yet did not guarantee a smooth airflow in this important region. Mounting the wing above the fuselage on a slight neck might not be aerodynamically ideal but saved a great deal of cost. In turns, any slight slipping or skidding would not upset the flow too greatly on the vital upper surface, which was entirely clear of obstructions.

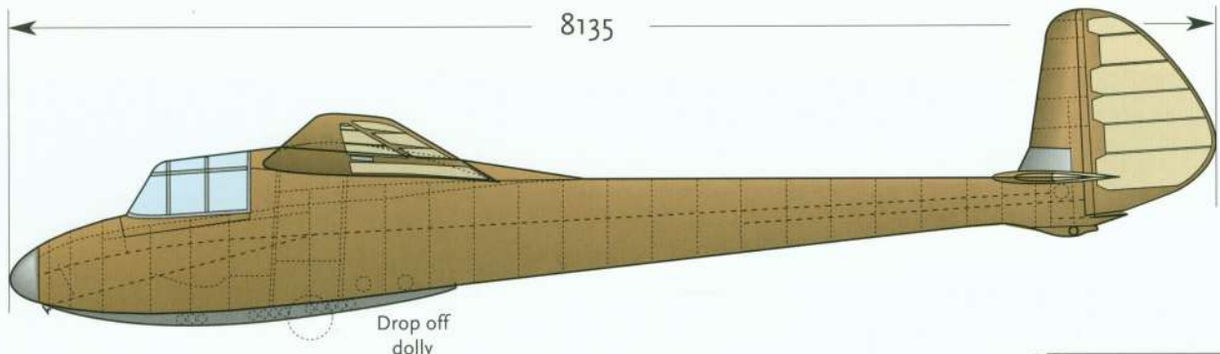
The air brakes, of DFS type, were set rather far back on the wing and proved less effective than desired. This was mainly because the geometry of their drive arms prevented them opening far enough for the paddles, above and below the wing, to meet the airflow at a full right angle. Sideslipping on the approach to small landing fields was necessary. Otherwise the Weihe handled well, was stable, strong and relatively easy to fly, both normally and blind in cloud.

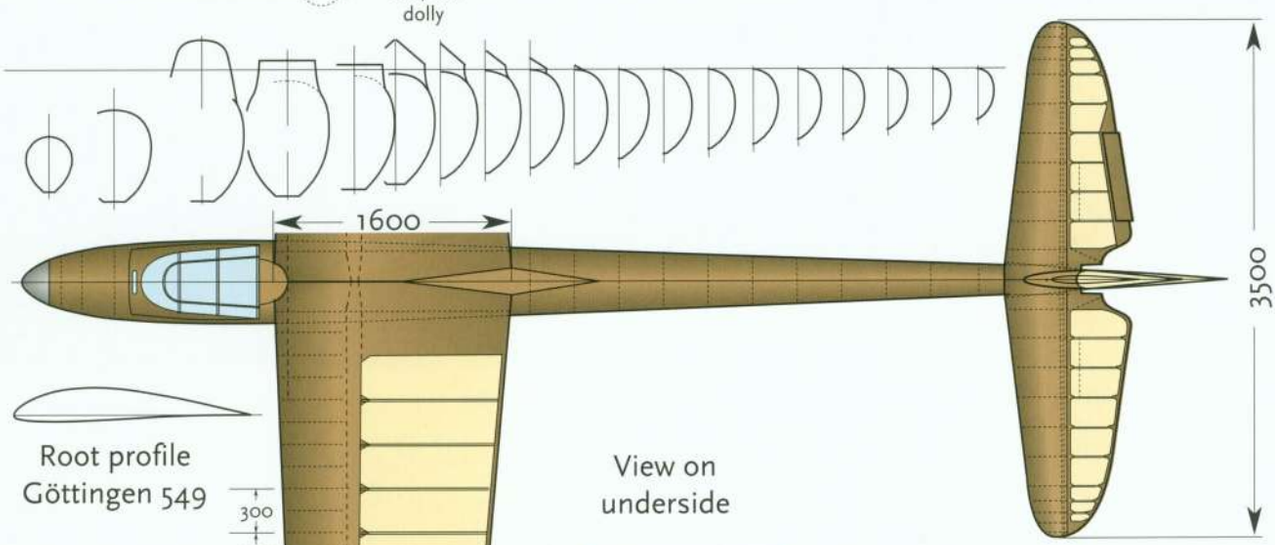
Particular attention was given to the system of rigging. Each wing was attached to the fuselage with two steel pins, one at the main spar and one close to the leading edge where there was a short sub spar. These two pins were in line axially and were inserted simultaneously by means of a toggle lever. There was no attachment to the fuselage aft of the main spar. When both wings were mounted, the

Above: This Weihe belonged to the Surrey Gliding club in England in the Post World War 2 period.

Right: Typical of its time, the Weihe skid was sprung with rubber balls. The gap was usually closed with canvas.

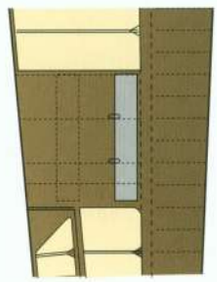
Below: The Weihe dominated competitions in the years immediately after World War 2.

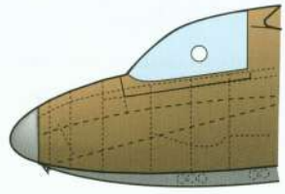




Root profile
Göttingen 549

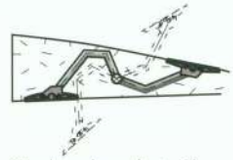
View on underside





Focke Wulf Weihe 50

Mid span profile
Göttingen 549



Air brake detail

Tip profile
M 12

Structure 215 kg
In flight 335 kg
Wing area 18.2 sq m
Wing loading 18.4 kg/sq m
Aspect ratio 17.8

Jacobs - Schweyer Weihe
1938

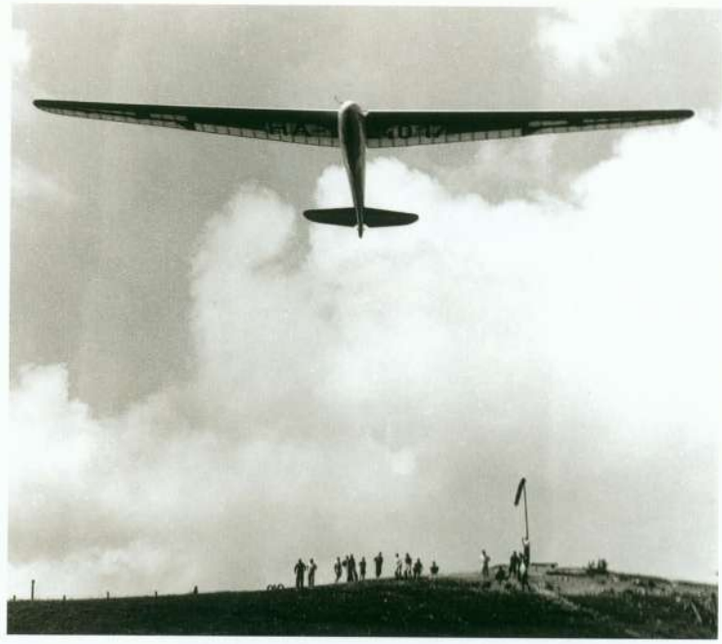
tips could rest on the ground without straining the fittings. To complete the rigging, the wing tips were raised until the top pin, joining the upper flanges of the main spar, could be inserted. The whole job could be done in a few minutes by a crew of two or three. The gap between wing and fuselage aft of the spar, was usually sealed with tape.

The Weihe first flew in 1938 and performed well. Otto Brautigam and Ludwig Hofmann in the Rhön contest that year placed fourth and sixth respectively, both in Weihes. The type was chosen by the NSFK for mass production. About 280 were built by Jacobs' own company, Jacobs - Schweyer, and many more under licence elsewhere. To speed production, many simplifications of the structure were made. In some factories plywood skin joints were simply overlapped and filled before painting, rather than the usual time - consuming smoothly scarfed joints. Any loss of performance was not apparent.

After the end of the Second World War, surviving Weihes captured in Germany and some built in Sweden and France (known there as the VMA 200 Milan) and Spain, were widely used and set a standard for designers for at least a decade. The type dominated competitions. Per Axel Persson of Sweden won the World Championship in 1948. Two other Weihes were in the top five. Billy Nilsson's Weihe, also from Sweden, won in 1950 with Paul MacReady's Weihe second. This was the occasion when MacCready demonstrated, in practice, his refined cross country speed flying theory which had, essentially, been anticipated by Späte in 1938. (MacCready's most welcome contribution was the MacCready ring which, mounted on the variometer, gave the pilot the best speed to glide between thermals of any given strength and in sinking air, without the need for slide rules, graphs and charts in the cockpit.) There were seven Weihes in the top ten that year. Even in 1954, sixteen years after the first flight, the Weihe was still competing in World Championships, three in the top ten. By this time some small production of a new version, the Weihe 50, had been undertaken by the Focke Wulf Company. The Weihe 50 had a landing wheel, a blown plastic cockpit canopy and, in some examples, ailerons of reduced length.

Many record flights were made in Weihes, including durations of 45 hours 28 minutes by Vergens in Austria in 1942, and 55 hrs 51 mins by Ernst Jachtmann in 1943 over the sand dunes of the Baltic coast. These records were officially disallowed by the FAI (Federation Aeronautique Internationale) because made in wartime, but they were genuinely flown. Axel Persson broke the world height gain record with 8050 metres in 1947 and Karl Bauer exceeded 9665 metres in 1959, both in Weihes. To list all the national records achieved in this aircraft would occupy several pages.

The Weihe's influence on sailplane design is clearly evident in such types as the Italian CVV 6 Canguro, French Air 100 and the British Slingsby Gull 4 and Sky. When designing his post war Kranich 3 two seater in 1952 Jacobs himself used what was essentially a Weihe wing. The most significant of all developments was probably that of the DFS Meise, which followed the Weihe in 1939



Meise/Olympia

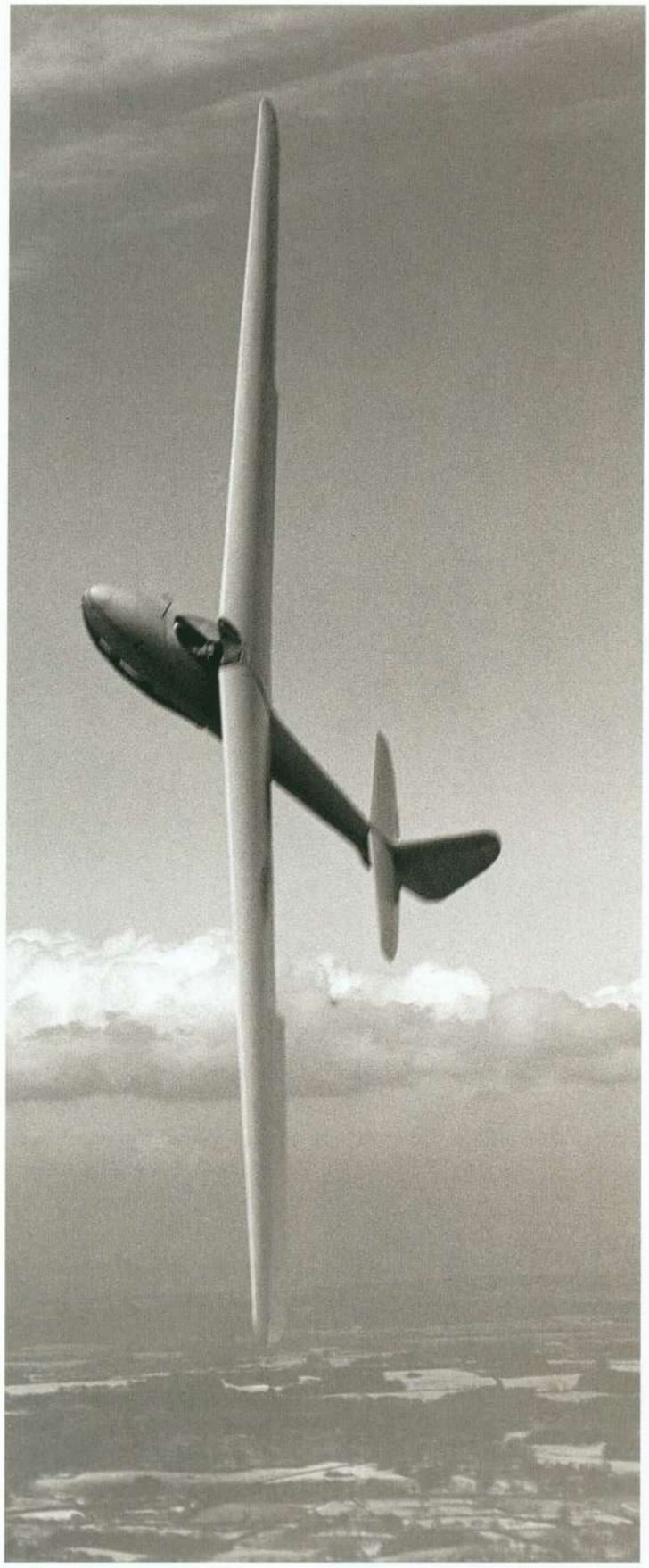
Led by Professor Walter Georgii and backed by ISTUS (International Studienkommission für Segelflug), there was a strong move during the nineteen thirties for soaring to be recognised as an Olympic sport. ISTUS arranged a series of international meetings and competitions, at Berlin in 1936 coincident with the Games, at Salzburg in May 1937 and the International Championships at the Wasserkuppe in July of that year. The Olympic Committee eventually accepted the sport but it was important that no pilot should have an advantage in equipment. The next Games were scheduled for 1940. All pilots in the Olympic competition should fly the same type of sailplane. Plans for a standard design, not too complicated or costly, must be made readily available so that any nation would be able to build aircraft for their team. A design competition was arranged. The specification was simple. The span must not exceed 15 metres, the structure weight no more than 160 kg, with a 102 kg allowance for the cockpit load. Permitted materials were spruce or pine, plywood and mild steel. The maximum permitted airspeed should be 220 kph. The load factor was to be 10g. No complicated fittings, no flaps, skid for landing, no wheel. An international jury was appointed with six members, one each from France, Germany, Britain, Netherlands, Italy and Poland. The completed 'Olympic' sailplanes were to be ready for test flying and assessment at Sezze in Italy, in February 1939.

The DFS entered the Meise. In most important respects this was a smaller version of the Weihe. The wing, with simple taper and no forward or backward sweep, was aerodynamically similar except that the root was again thickened slightly for greater spar depth. The large Schempp Hirth type brakes were much more effective than those of the Weihe. The fuselage aft of the wing had almond or lozenge shaped cross section for greater ease in applying the plywood skin. For balance, the pilot's seat had to be just ahead of the

Opposite page: The Meise, winner of the 1939 design contest. This example was flying in Hungary.

Above: An Olympia flown by the British Empire Test Pilots' School.

Left: The prototype British Olympia built by Chilton Aircraft Co, finished in clear dope and varnish.



main spar. This necessitated a slightly awkward design of cockpit canopy, which fitted into a cut out between the two wings and gave the pilot a fairly adequate view upwards and to the sides. It was not then possible to use the simple rigging system of the Weihe which involved a connection close to the leading edge. There was an orthodox rear attachment point with a short diagonal spar to carry the torsional loads. For simplicity, there were no fairings around the wing roots.

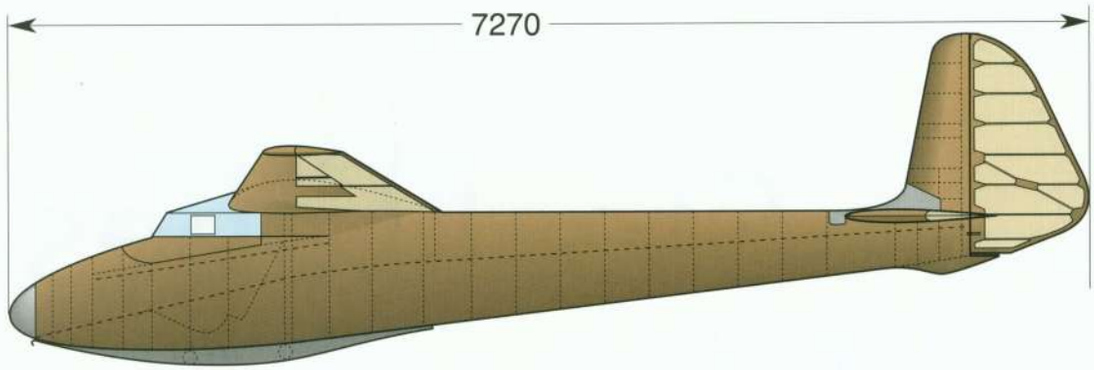
By good judgment and, perhaps, an element of luck, the Meise proved to have excellent handling qualities, so much so that Philip Wills, the English champion pilot, described the Meise as a piece of poetry, perfectly balanced in all senses and a delight to fly. At Sezze it was judged to be the best of the five sailplanes in the design competition. The DFS accordingly published the plans and these were widely distributed. The name Olympia was applied.

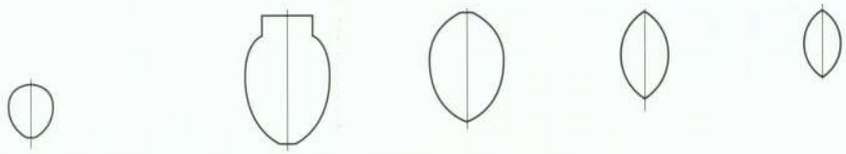
The 1940 Olympic Games never took place. By then Germany, Britain and France were at war and, in a separate conflict, Finland where the Games should have been held, was also struggling desperately in the so called 'Winter War' against the USSR. The Meise was nevertheless adopted by the NSFK and produced in large numbers in Germany.

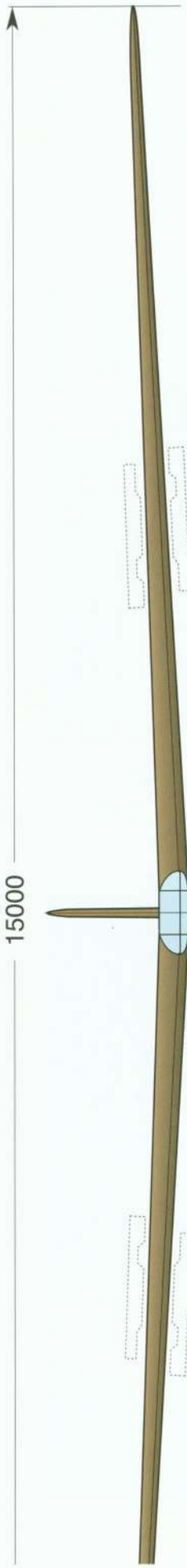
After the war, the plans being available, a few were built by amateurs, at least one in the USA and one, known as the Yellow Witch, in Australia. Quantity manufacture was undertaken in France (as the Nord 2000), the Netherlands, Switzerland, and eventually in Germany again as the Olympia Meise 51. In Britain, after some restressing and strengthening (probably unnecessary), about 150 were built in batches by Elliotts of Newbury. The EON Olympia 2B with a blown plastic cockpit canopy and a landing wheel was, from 1947, the backbone of the club sailplane fleet in Britain and examples were exported. Many remain in service.

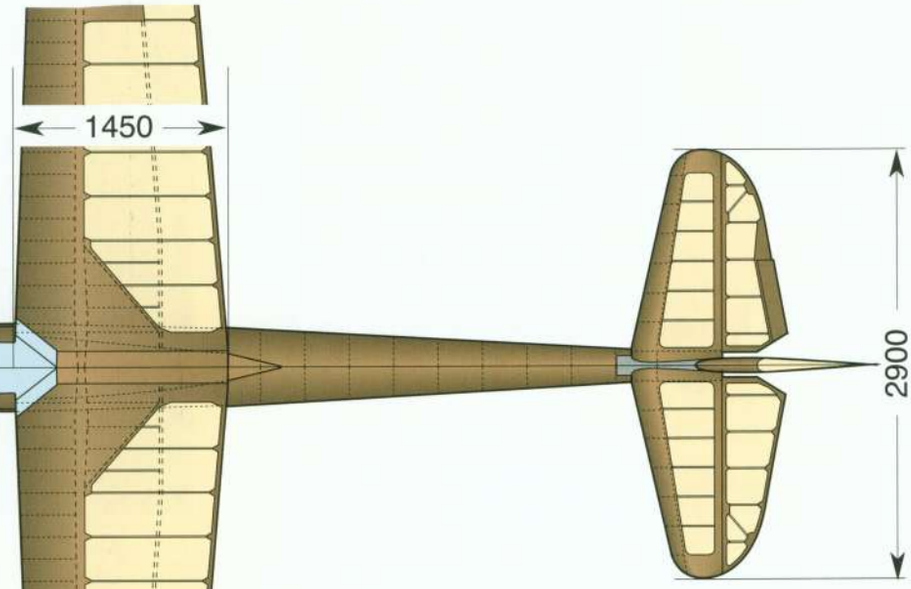
The Meise was Hans Jacobs last pre-war contribution to sailplane development. In post war times he produced only one further design, the two seat Kranich 3. The book he had first written in 1932, Werkstatt-Praxis Für den bau von Gleit und Segelflugzeugen (Workshop practice for building gliders and sailplanes) expanded and updated in new editions, became and remains the standard work on the subject of building and repairing wooden sailplanes.

A famous photograph of an Olympia, used by Elliotts of Newbury for their advertising brochure. Photographer, Charles E Brown.

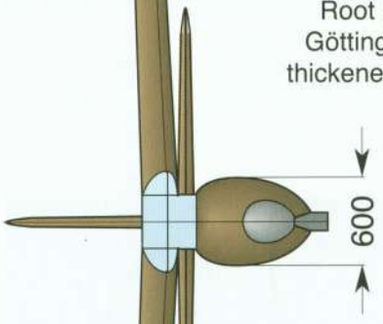


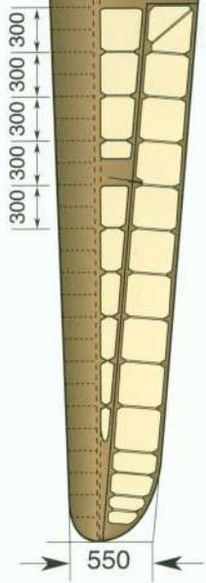






Root profile
Göttingen 549
thickened to 16%





Structure 160 kg
In flight 255 kg
Wing area 15 sq m
Wing loading 17 kg/sq m
Aspect ratio 15

DFS Meise (Olympia) 1939

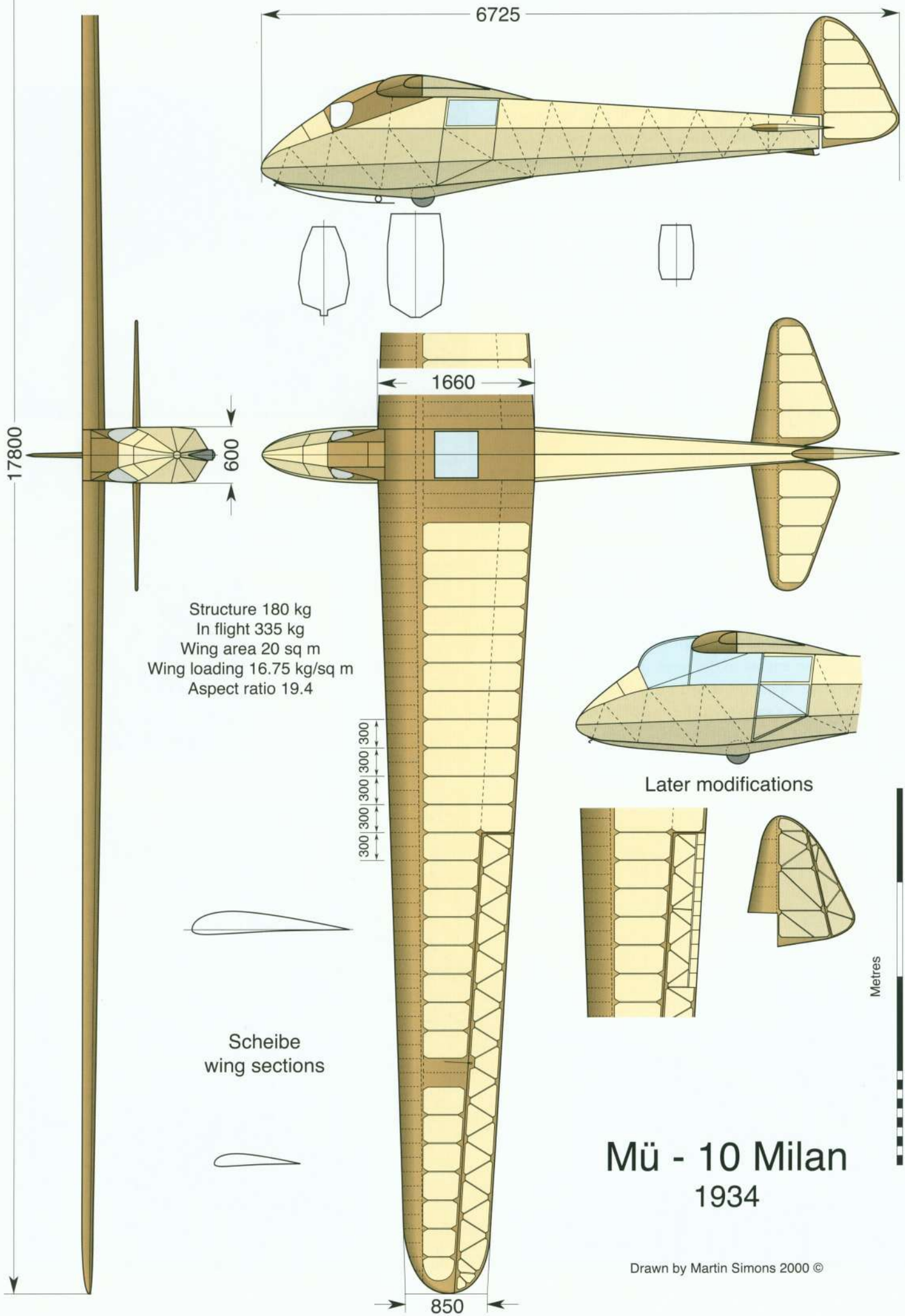
Tip profile
Göttingen 676
(5 degrees washout)

Chapter 11 Steel tubes and fabric

Münich Mü 10 'Milan'

The student Academic Flying Group at Münich was founded in 1924. In 1933 under their leader, Egon Scheibe, they set about the design and production of a two seat sailplane, the Mü 10 Milan. This was very original. The fuselage was a welded steel tube frame covered with fabric, not very unusual for powered aircraft but, apart from the gigantic Obs of Lippisch, the first time it had been applied to a sailplane. The second pilot had a cabin under the wing, with access door and windows not only at the sides but above. The front pilot was enclosed in a wooden hood with portholes. This was soon replaced by a fully transparent canopy. The wing was of orthodox wooden construction. The aerofoil sections used were of Scheibe's own devising, most of the camber concentrated at the leading edge with the upper surface, aft of the maximum thickness point, almost flat. The NACA in American were currently developing and testing

Above and below: The Mü 10 'Milan' D - 14 - 126 at Salzburg in 1937. Other sailplanes visible include a Condor 2A. the Rheinland. a Swiss Spyr 3 and the French Avia 41P and others unidentified.



Structure 180 kg
In flight 335 kg
Wing area 20 sq m
Wing loading 16.75 kg/sq m
Aspect ratio 19.4

Later modifications

Scheibe
wing sections

Mü - 10 Milan
1934

the 'five digit' series of profiles which had similar reasoning behind them, reduced twisting and pitching moments and high maximum lift coefficients. The ailerons and rudder were given servo tabs to lighten the forces required on the control column.

The first flight was in 1934 and proved successful. The Mü 10 set a world distance record for two seaters of 180 km in 1935 and was one of several sailplanes participating in a soaring tour or safari covering 700 km in stages round Germany. At the ISTUS International meeting at Salzburg in May 1937, the Mü 10, flown by Ludwig Karch, made an outstanding flight across the Alps, achieving a distance of 195 km and a height gain of 2980 metres, a world record for two seaters.

The Mü 10 spent some time in the Munich Deutsches Museum after World War 2, but was rescued from there and flown again for some years before returning to the Museum at Oberschleissheim where, perfectly restored, it remains.

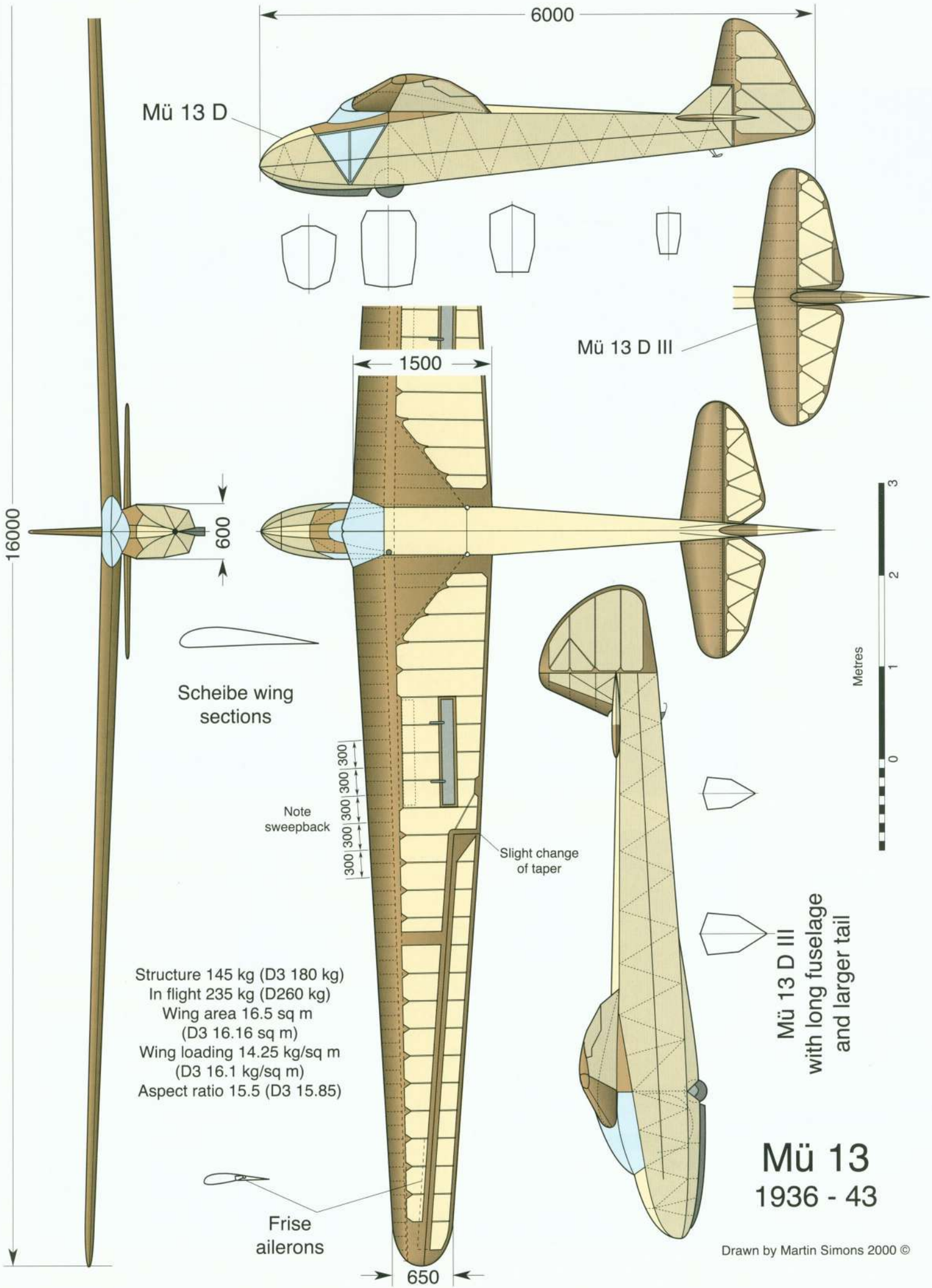
Above: Cockpit canopy and transparencies of the Atalante.

Mü 13

Kurt Schmidt, Tony Troeger and Egon Scheibe, who had designed the Mü 10 Milan two seater, decided in 1935 to build two lightweight single seat sailplanes using the same construction methods: welded steel tube fuselage covered with fabric, and wooden flying surfaces. Troeger was interested in a motor sailplane and his Merlin was designed to take an engine in the nose, with a retracting two wheeled undercarriage. Schmidt named his aircraft Atalante and was content to have it as a sailplane. They used the same Scheibe profiles as for the Mü 10. Because the fuselage was so light and the tail short, for balance the seat was under the leading edge of the

Right: Kurt Schmidt in the Atalante cockpit. Vision sideways was almost nil.

Below: The Mü 13 'Atalante'



Structure 145 kg (D3 180 kg)
In flight 235 kg (D260 kg)
Wing area 16.5 sq m
(D3 16.16 sq m)
Wing loading 14.25 kg/sq m
(D3 16.1 kg/sq m)
Aspect ratio 15.5 (D3 15.85)

Mü 13
1936 - 43

Above: The Mü 17 'Merle', one of the two German entries in the Olympic sailplane design contest.

Opposite page above: The cockpit and canopy of the Mü 17. Unlike the earlier Mü series, the main spars joined on the centre line.

Opposite page small picture: Reiner Karch was the test pilot for the Mü 17

wing, which created difficulties for the pilot's vision. Large windows were provided in the cockpit sides. There were camber flaps for landing.

In the 1936 Rhön competition, Schmidt took advantage of the very light soaring conditions that prevailed that year and won against all the much more expensive and refined sailplanes. Some modifications were made in the following year and by 1938 the Mü 13D appeared. The flaps had been eliminated and replaced by air brakes, the wing was slightly swept back, and a tailplane with elevator was used rather than the all moving surface. The Mu 13D was put into production at the Black Forest Aircraft factory. At the 1939 Rhön fifteen of the type were entered. Production reached about 150.

The Mü 13D was not considered easy to fly because lateral control was sluggish, despite the addition of 'Frise' type ailerons. After further trials, in 1943 the Mü 13D - 3 was developed, which had a longer fuselage of more triangular cross section behind the wing and larger rudder. Control was improved.

Several of both types survive.

Mü 17

The Mü 17 was the Munich group's design entry for the Olympic sailplane design competition which, in 1939, was won by the DFS Meise. It failed to impress the judges sufficiently, but it had some success and was produced in some numbers after the end of World War 2. About two dozen were produced in total.

Helios

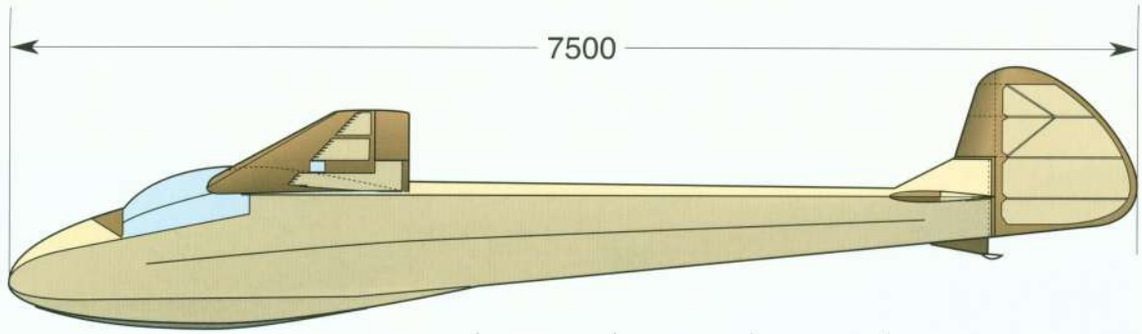
The small and inexpensive Helios was designed and built by a group of young Berliners in a great hurry, in time for the 1934 Rhön competitions. It had many innovative features. The wing, swept back and with gull dihedral, was wooden but the slotted ailerons were very unusual for the time, being framed in duralumin. There were no spoilers or air brakes. The fuselage was a welded steel tube frame with fabric covering. The seat was just ahead of the main spar so that the pilot's head was within the leading edge. An enclosed transparent canopy, with the plastic panels sewn onto the frame with leather strips, faired the fuselage to the wing with minimal disturbance of the airflow. View outwards was nonetheless extremely limited.

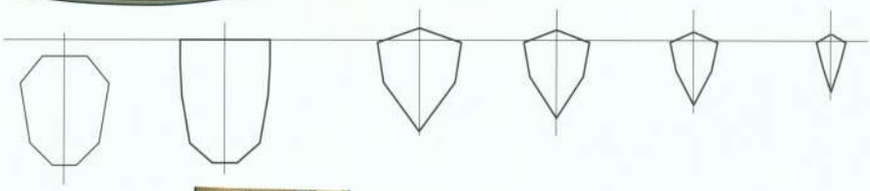
Below and opposite page below: Helios

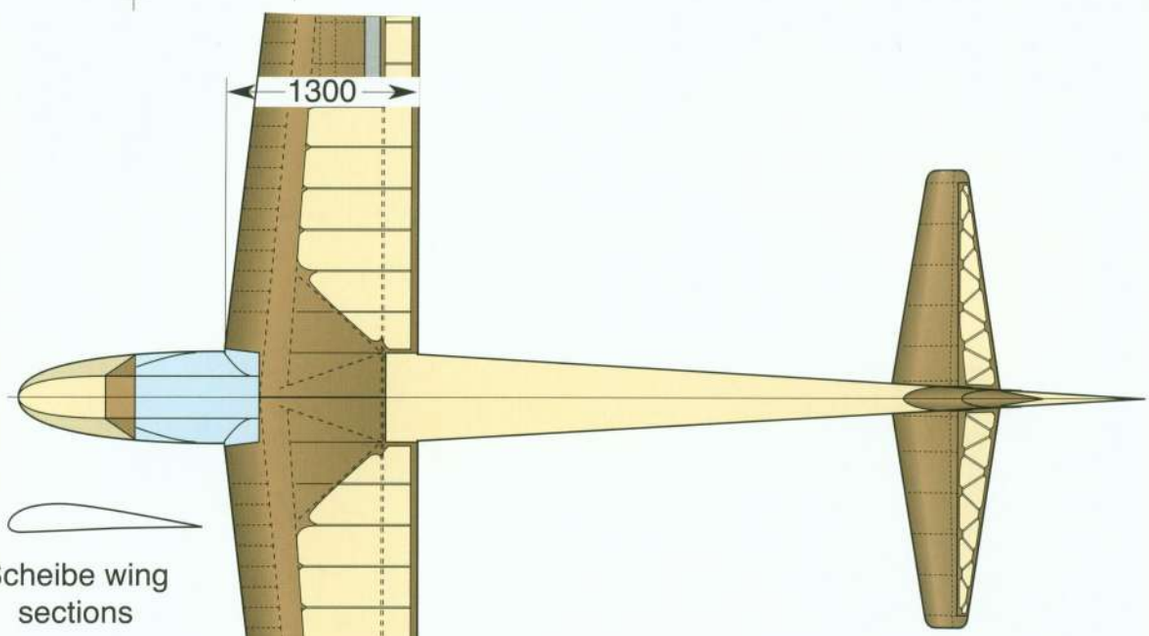
In the competitions the Helios, flown by Heinz Kensche, one of its youthful designers, was assigned to the junior division. Most of the pilots in this section were flying Grunau Babies, but there were a few Rhönbussards and Condors, and the first of the Horten tailless sailplanes, the H - 1 (which made only one scoring flight). The Berlin group were pleased with their results. They had put together a small and inexpensive sailplane in a matter of weeks, and had flown it across country. Kensche in 1937 was the German representative on the Olympic sailplane design jury.


Merle

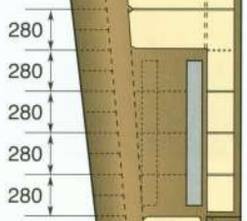

D-HELIOS

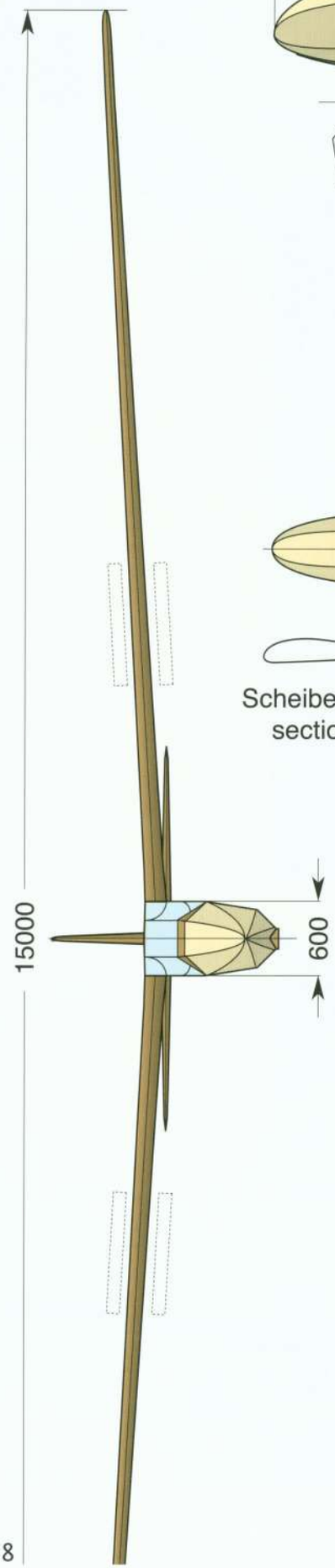


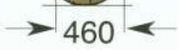


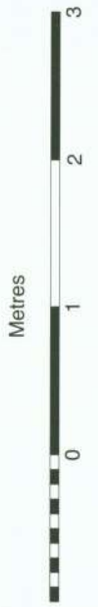


Scheibe wing sections



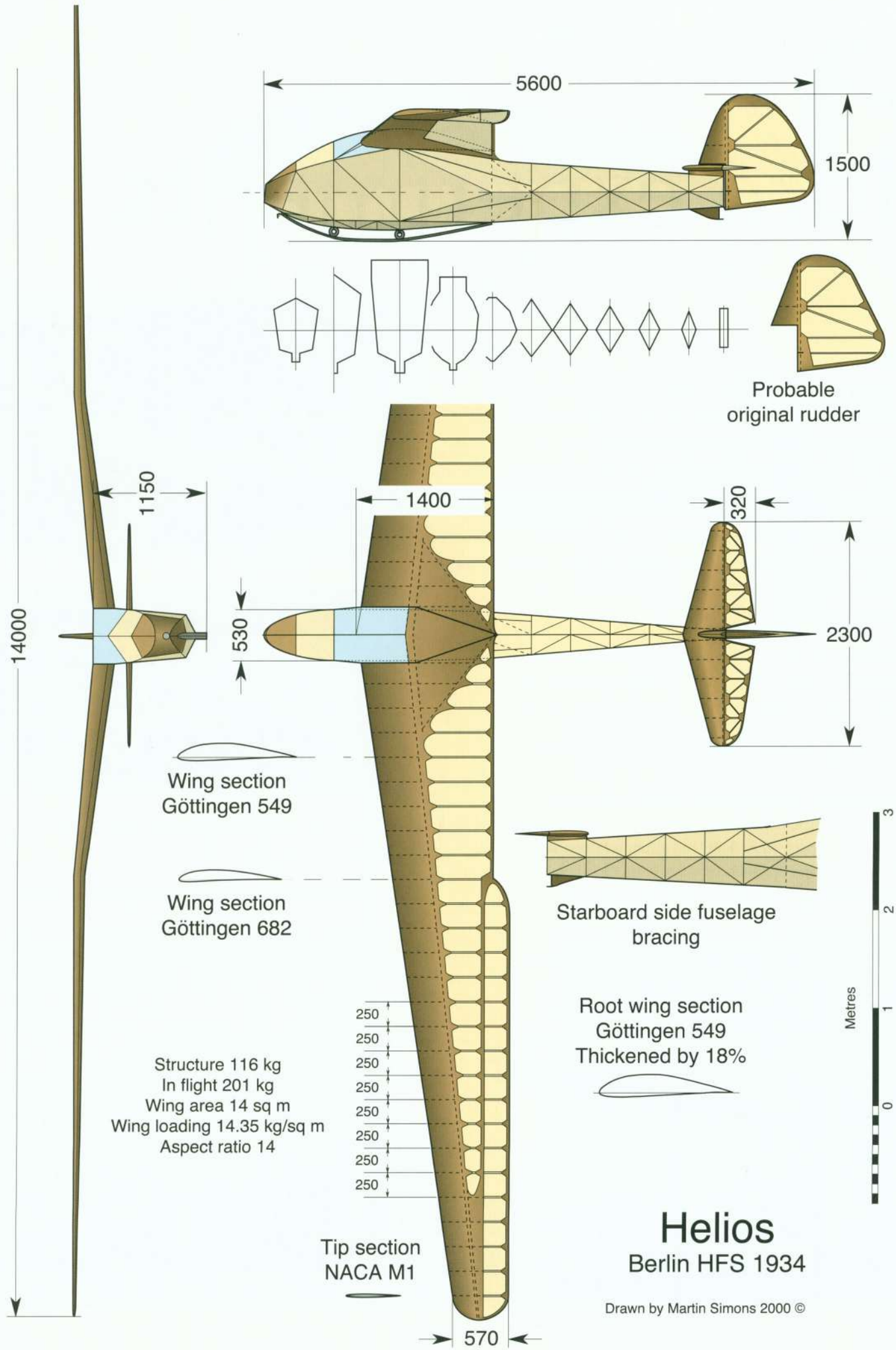






Structure 160 kg
In flight 255 kg
Wing area 13.3 sq m
Wing loading 19.2 kg/sq m
Aspect ratio 16.9

Mü 17 'Merle'
1939



Helios

Berlin HFS 1934

CHAPTER 12

More experiments

Rheinland

Akaflieg Aachen designed the FVA 10 Rheinland in 1935. The students were impressed by wind tunnel results which suggested that drag could be saved by shaping the fuselage like an aerofoil section, to conform as far as possible to the flow around the wing. The belly of the fuselage in side elevation was almost flat and would have been vulnerable to damage on rough ground. Led by Felix Kracht, they therefore designed a semi retracting wheeled undercarriage which also had the advantage of increasing the wing angle of attack when taking off and landing. The prototype was named Theo Bienen in honour of one of the earliest chairmen of the Akaflieg who had flown the Schwatze Düvel and the Blaue Maus. It was built in the workshop of Ferdinand Schmetz and flew in 1936.

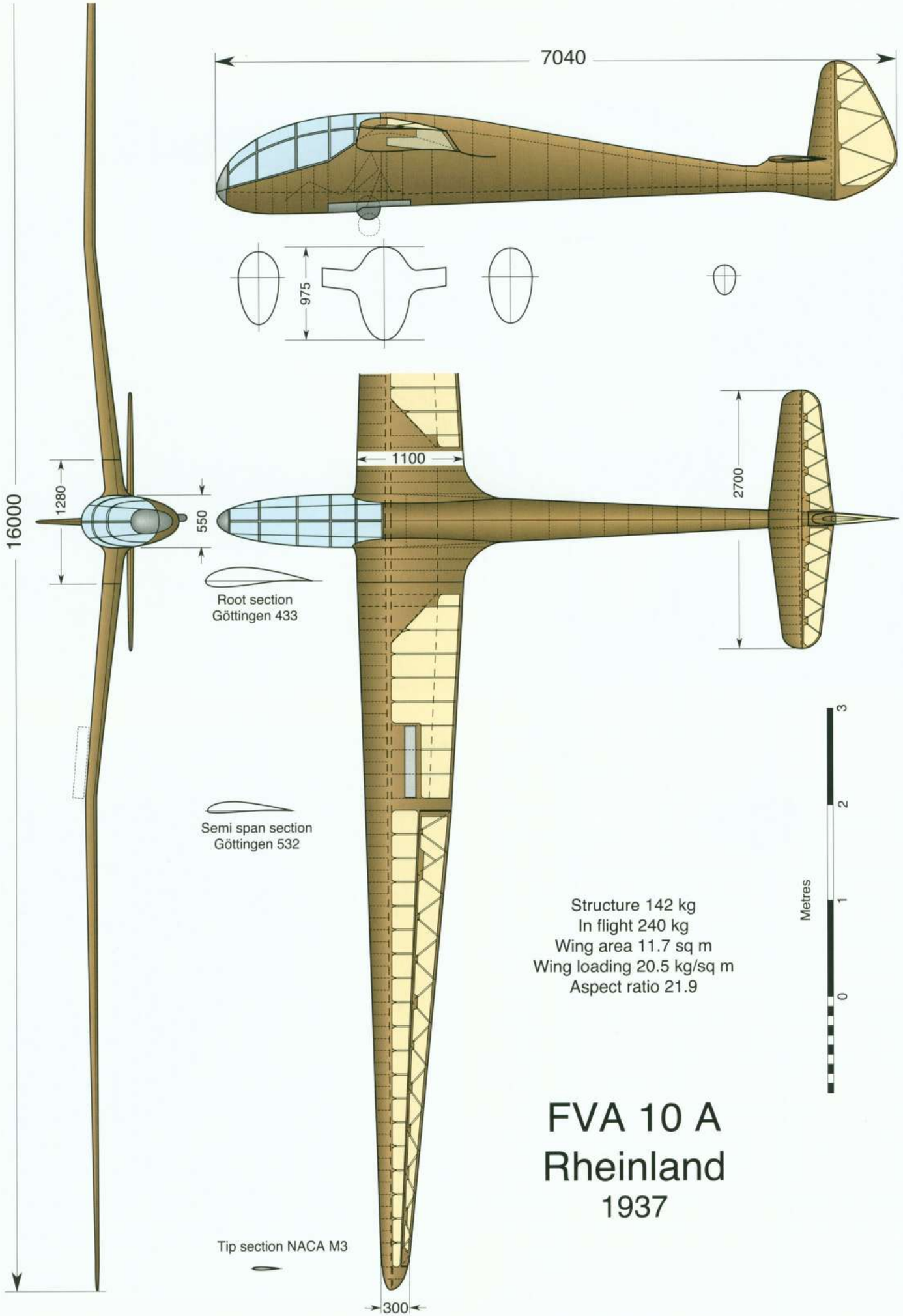
The performance in the air was excellent but handling was less satisfactory and the stalky undercarriage proved rather too easily damaged in bad landings. With changes, the FVA 10A was ready for the 1937 ISTUS meeting in Salzburg, where it did extremely well and Kracht also took second place at the 1937 Rhön competitions. The sailplane won the design prize.

Schmetz and Kracht started a small company to produce the Rheinland. However, its distinctive fuselage shape was abandoned. The FVA 10 B had a rather more spacious cockpit, and a simpler streamlined fuselage. About 30 were built, one of which survives. A single example of the earlier, flat bottomed types, is in a museum in Krakow, Poland.

Above: Rheinland D - 12 - 99 at the Salzburg international meeting.

Middle: The FVA 10B Rheinland

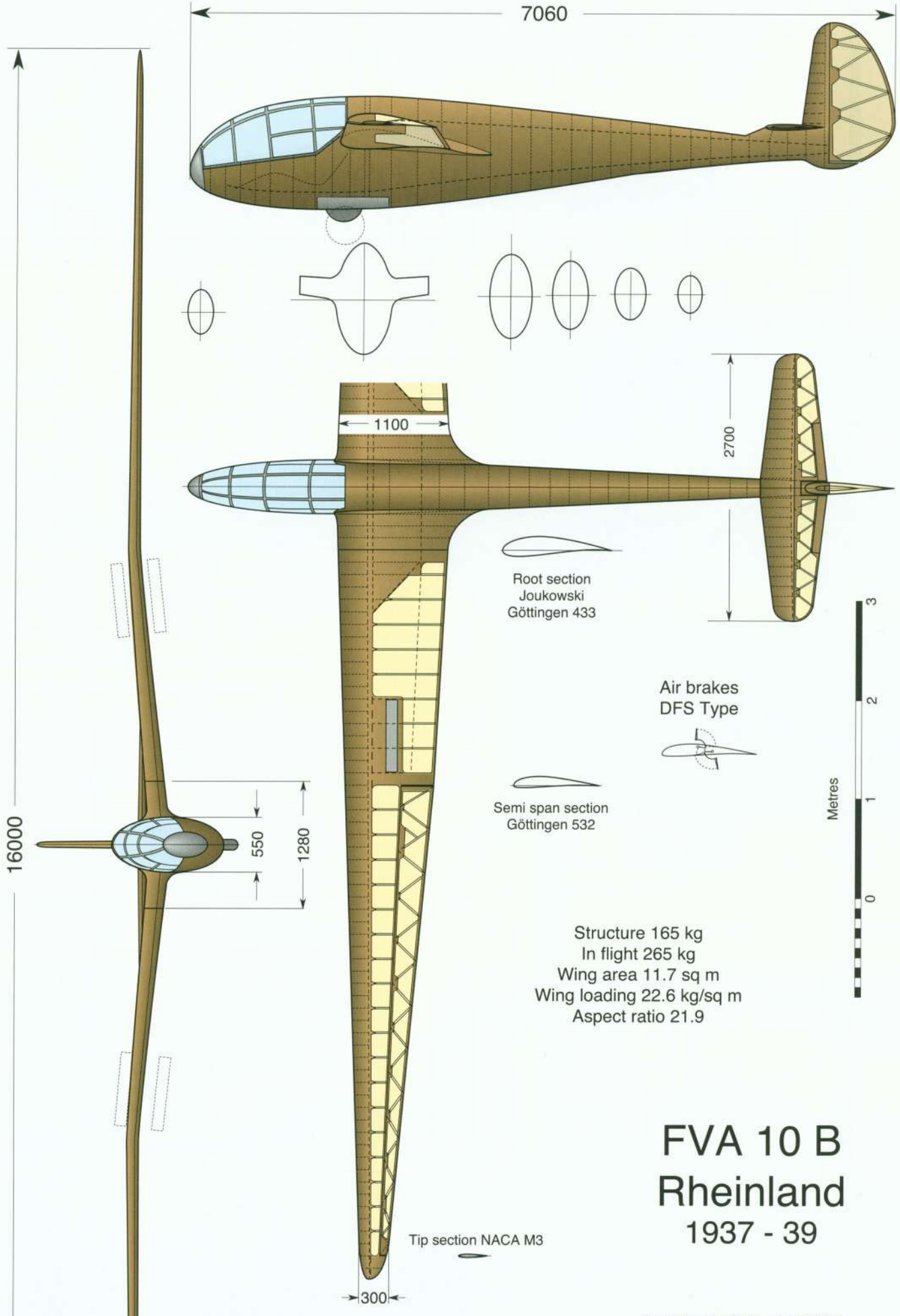
Below: The Rheinland D - 12 - 99 competing in the 1937 Rhön competition.



Structure 142 kg
In flight 240 kg
Wing area 11.7 sq m
Wing loading 20.5 kg/sq m
Aspect ratio 21.9

FVA 10 A Rheinland
1937

Drawn by Martin Simons 2000 ©



Structure 165 kg
In flight 265 kg
Wing area 11.7 sq m
Wing loading 22.6 kg/sq m
Aspect ratio 21.9

FVA 10 B Rheinland
1937 - 39

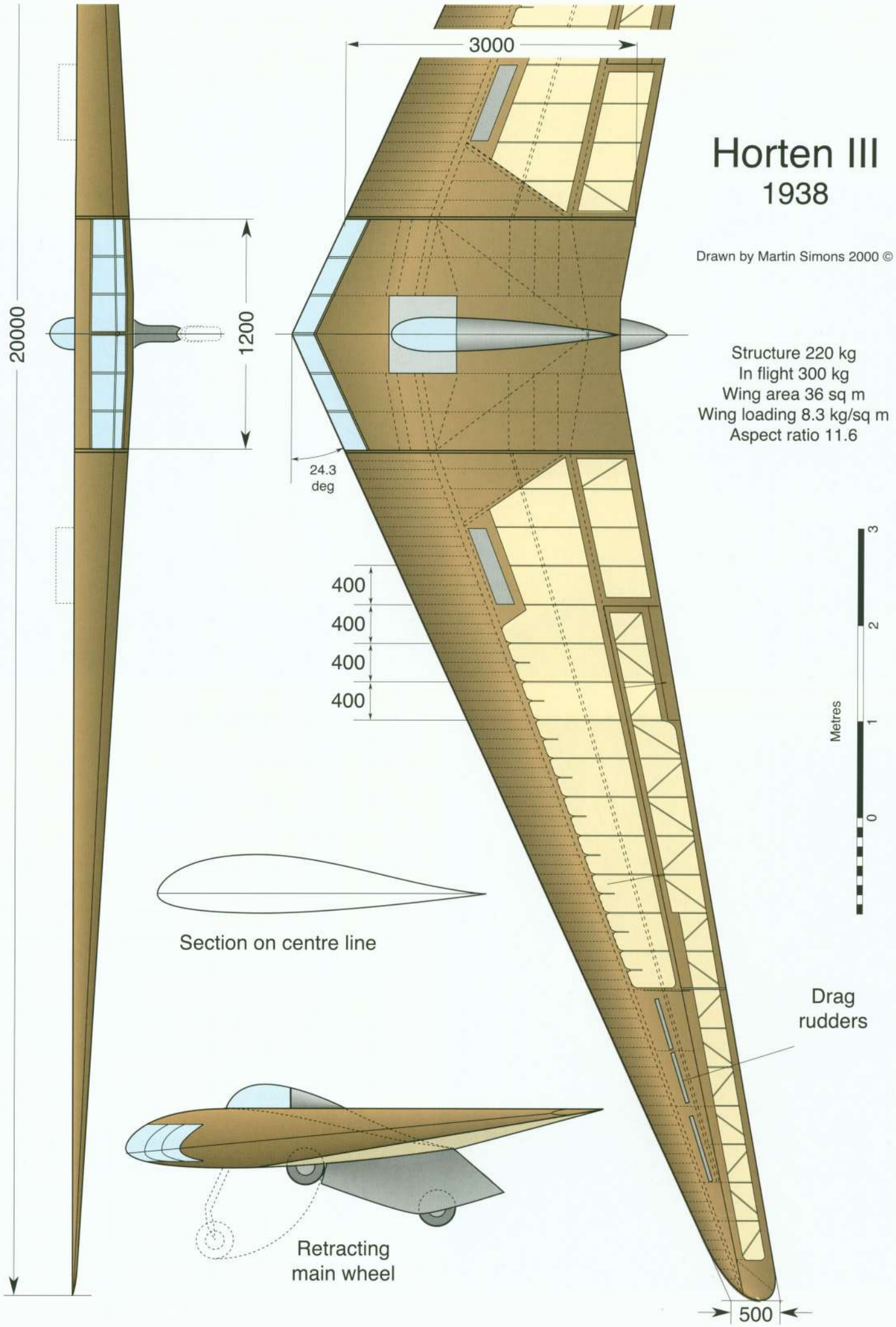
Above: Two Horten III in 1938 Rhön contest.

Left: Horten IIIf (prone pilot)

The Hortens

Walter and Reimar Horten became interested in tailless aircraft after seeing Lippisch's Storch and Delta, and like Lippisch they tested many models before beginning a full scale sailplane, the Horten I, which they took to the 1934 Rhön competitions. Although it flew for a total of about seven hours it recorded only one official contest flight. They abandoned and burned it on the Wasserkuppe, returning home to build the Horten II, which flew as a sailplane in 1935 and was much more satisfactory. It was fitted experimentally with a motor. Three more H II sailplanes were built and two of them flew in the 1937 competitions.

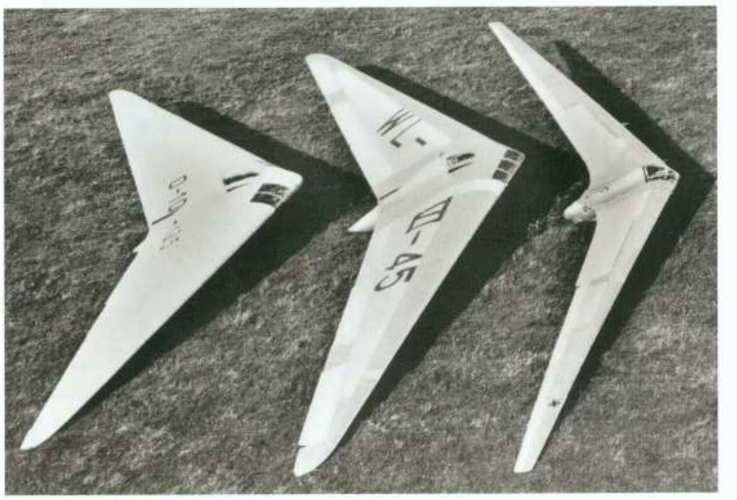
Able to find some official backing for their work, the brothers produced the Horten III in 1938. This was a very large sailplane which flew most impressively. Rudder control was provided by wing tip brakes. The cockpit was in the middle of the wing, with a streamlined transparent canopy, but there were also large transparent panels in the leading edge to give a view of the ground. The undercarriage was partly retractable. Several different versions were built. Two of these competed in the 1938 Rhön, one, designated Horten III C, had a small auxiliary wing mounted just ahead of the



Horten III
1938

Drawn by Martin Simons 2000 ©

Structure 220 kg
In flight 300 kg
Wing area 36 sq m
Wing loading 8.3 kg/sq m
Aspect ratio 11.6

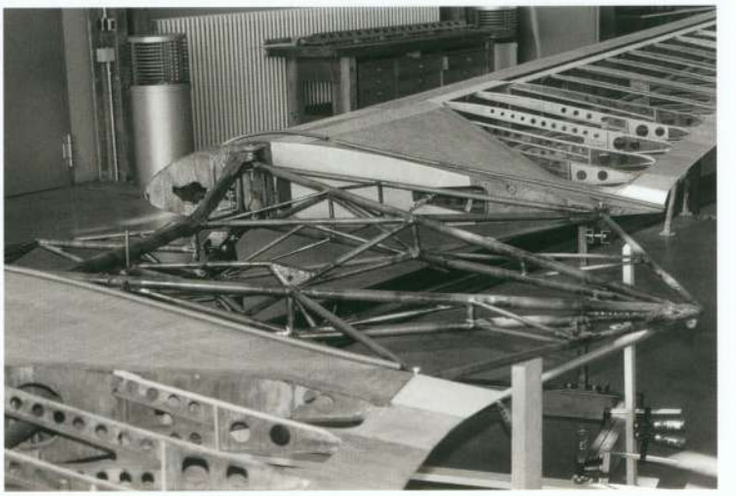


Above: The only known photograph showing Hortens II, III and IV together.

Middle: The pilot's position in the Horten IV.

Left: Horten IV in flight.

Below: The centre section of the Horten IV under reconstruction.



cockpit. Unfortunately, Blech, the pilot of one of these aircraft, was killed on impact in a mid air collision in cloud. His automatic parachute brought his body to earth. The Horten III D had a motor with a folding propeller.

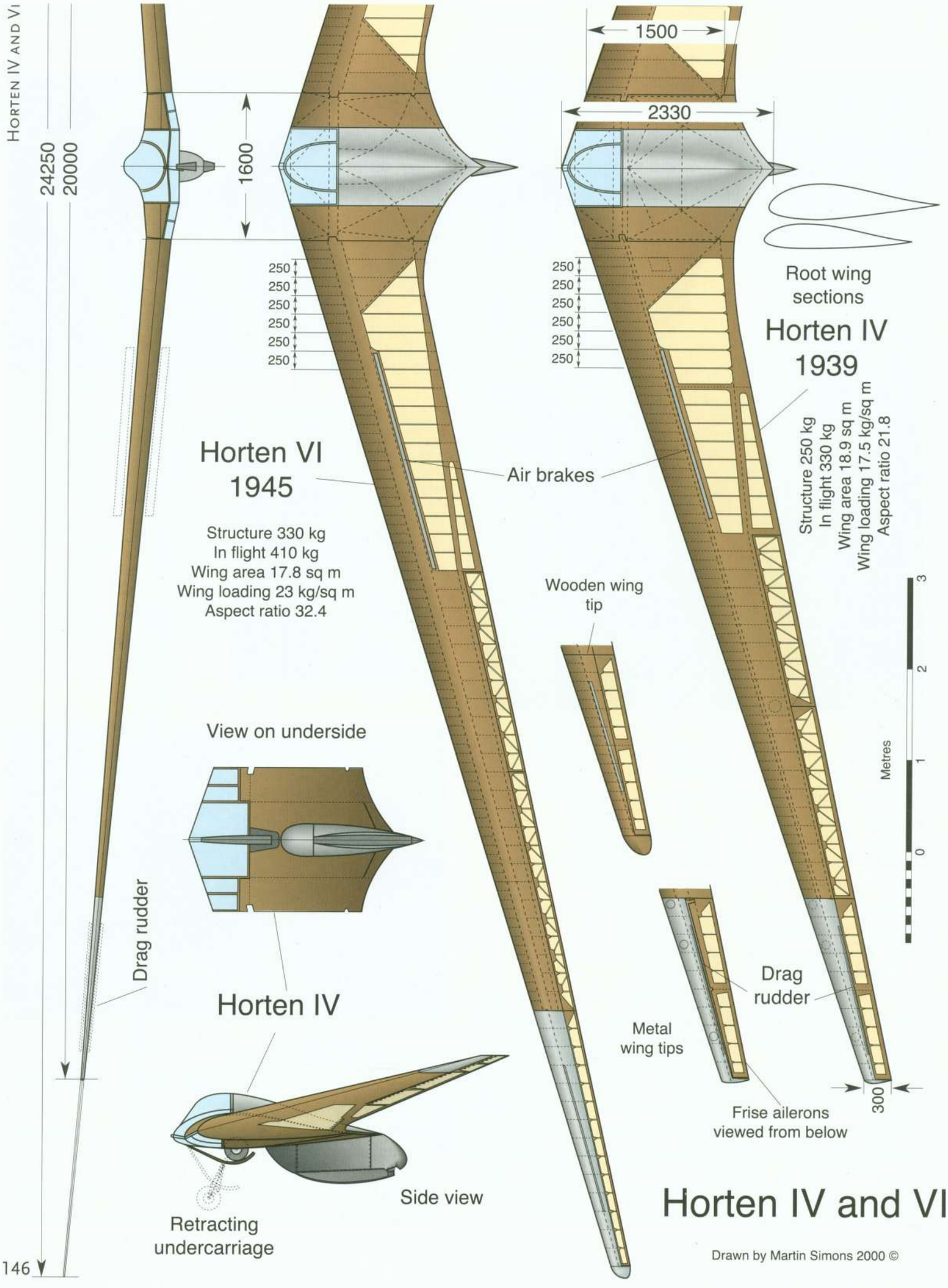
Four pilots flew Horten IIIs in the 1939 competition but did not do remarkably well. As contest sailplanes these aircraft were considered too lightly loaded and slow. Higher wing loadings and higher aspect ratios were required for cross country flying. The type was also used extensively in further experiments with motors, one was tried with a prone pilot, and there was a two seat version. Sixteen were flown altogether.

The Horten IV of 1941 incorporated all the lessons learned from the earlier types. The wing had a high aspect ratio, the pilot was in a semi prone or half kneeling position faired with a smoothly contoured canopy. The controls were operated by a yoke and there was a padded chin rest, essential if the pilot was to look directly ahead for long periods. The undercarriage was retractable to reduce all sources of parasitic drag. The wing tips, very thin and narrow, were fabricated in light alloy. Flight tests showed that the sailplane was fully controllable although no one described it as easy to manage in the air. Centre of gravity placement, as usual with tailless aircraft, had to be very precise. The performance was not as good as expected.

A Horten IVB, with a 'laminar' flow wing profile copied from the American P - 51 fighter, was flown but proved dangerously liable to flutter, and crashed killing its pilot.

The Horten V was a powered aircraft and there was an experimental flying wing of parabolic plan form which never flew.

The Horten VI, two of which were built in the closing months of World War 2, had a wing span of 24.25 metres in an attempt to improve the performance. A best glide ratio of 43:1 was anticipated.



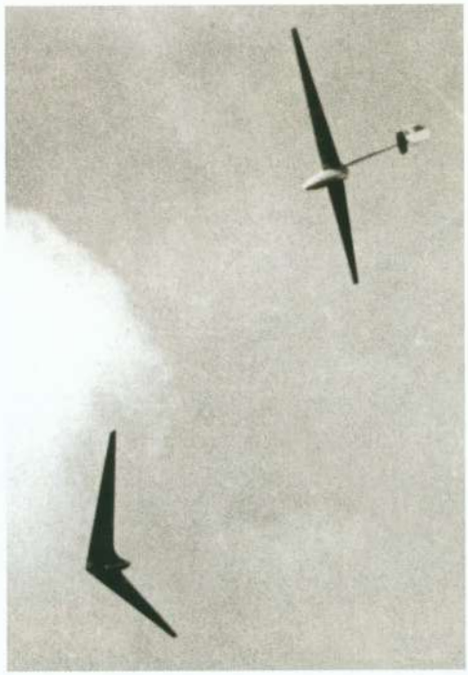
Horten IV and VI

Drawn by Martin Simons 2000 ©

Flight tests were started but had to be curtailed as the American armies captured Göttingen where the tests were going on. One of the Horten VIs was taken to the USA for study by the Northrop Company, but did not fly again.

One Horten IV survived in Germany to be flown by the British Air Force until damaged seriously in a landing accident at Scharfoldendorf. The wing tips had been at some time replaced with wooden tips. A Horten IV was extensively flown in the USA in post war times and was the subject of a thorough study at the Mississippi State University in 1959, and reported to the OSTIV Congress in 1960. The results were not as good as expected. In recent years, one of the surviving Horten IVs, probably the one used by the British in 1946 - 8, has been completely restored at the Oberschleissheim division of the Deutsches Museum in Munich.

The Horten brothers continued to design tailless aircraft after the war, producing both sailplanes and powered aircraft.

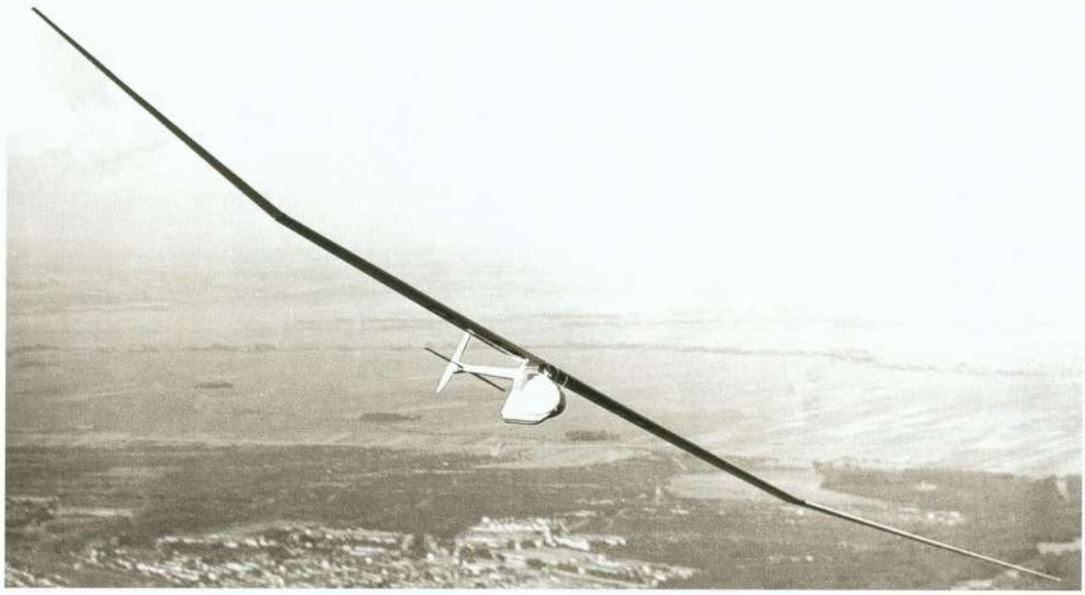


Above: Horten IV and D - 30, in comparison tests.

Below: The D - 30 in it's original form, with Bernhard Flinsch.

D - 30 Cirrus

The Darmstadt Akaflieg began paper work for the D - 30 in 1933, intending to use all the latest discoveries in aerodynamics and structural design to obtain the best possible gliding performance. The aircraft they produced was a record breaker in every sense. The wing had the highest aspect ratio ever employed until that time, 33.6. This could not be built in wood. A broad main spar of duralumin alloy was built up from corrugated sheets, the overlying skins flush riveted and curved to conform to the aerofoil shape. Behind and in front of the spar, wooden wing ribs were attached with plywood skins. The joins between wood and metal skins were carefully filled and smoothed for a good quality painted finish. Ailerons and flaps were fitted, and there were air brakes.



Above: The original D-30 in flight with positive dihedral.

Below: The D - 30, now repaired and with a new registration D-11-880. Note the improved transparent canopy.

The wing profiles were chosen from the recently published American NACA 4 digit series, 2412 (12% thick, 2% cambered) at the root, tapering to the 4412 (4% cambered, 12% thick) at the tips. The increase of camber at the tips reduced the risk of tip stalling since, measured from the zero lift position, a more cambered form stalls at a high lift coefficient and at a higher aerodynamic angle of attack. (This, in 1933 was the reverse of the usual technique but is almost universally followed in modern sailplane design.) Since the wing was tapered, some 'wash in', positive twist, was introduced over the inner wing, with washout thereafter, to increase the lift slightly over the middle portion, approximating the ideal elliptical load distribution.

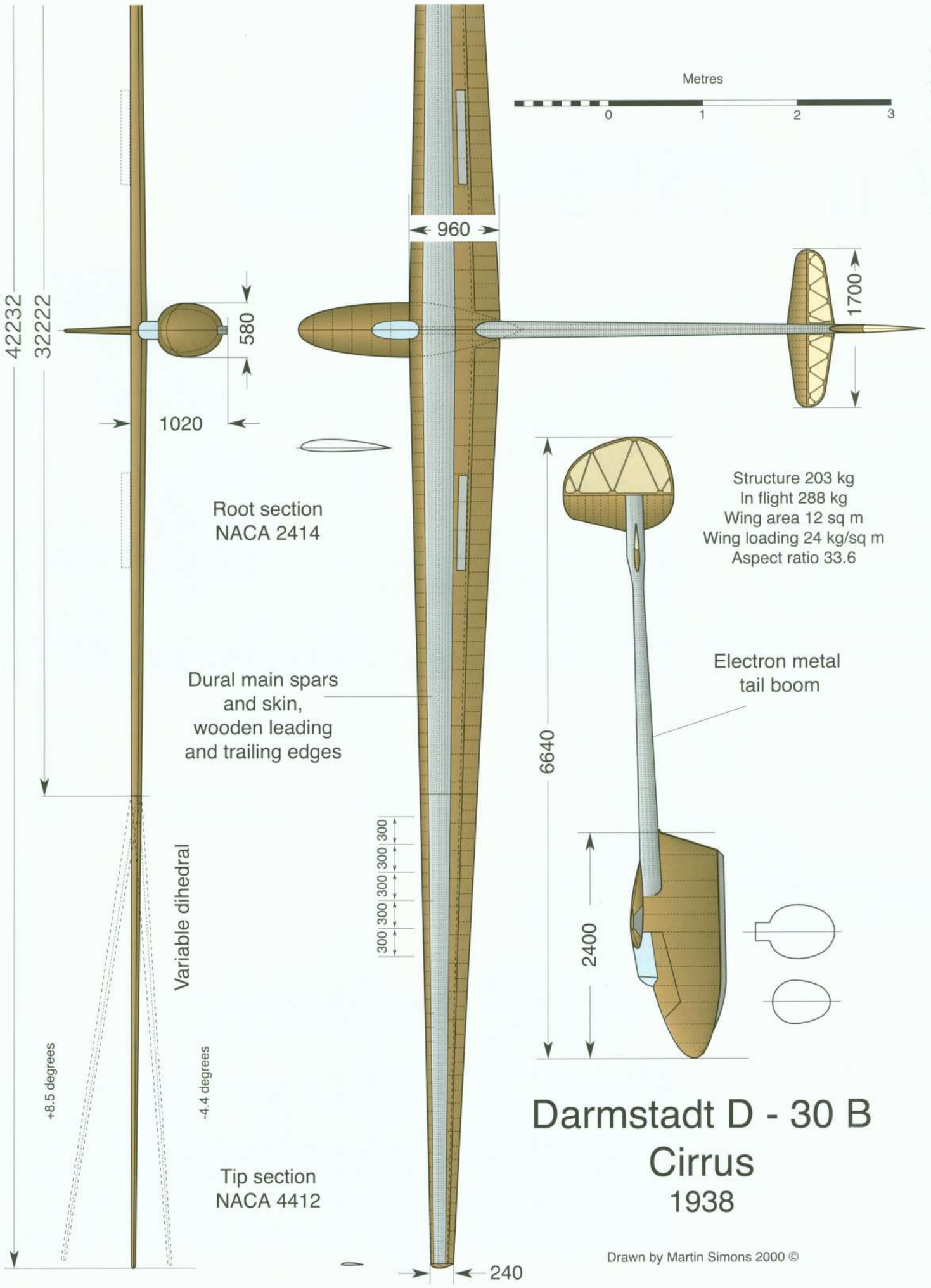
Most unusual of all, at the mid span point the wing had a pivot which allowed the dihedral to be changed in flight. This was for an investigation into the effects of dihedral on handling. The design and fabrication of the necessary mechanism, which had to fit within a wing of only 72 mm thickness, was very difficult.

The fuselage was of the 'pod and boom' type, a small streamlined plywood shell housing the pilot, with a tubular tail boom fabricated from electron alloy. The cross sectional area of the pod was small, and skin friction was saved by reducing the area of surface exposed to the airflow. The Horizontal tail surface was small, stability in pitch being determined mainly by a centre of gravity well forward. But the vertical tail could not be reduced too much since control in yaw, with such a large span, would become marginal. As it was, after test flights, the rudder was enlarged. Take off was by means of a 'drop off' wheeled dolly, landings on the skid.

The sailplane was not completed until 1938 but, flown by Bernhard Flinsch, it very soon broke the World 'out and return' record, 305.6 km from Bremen to Lübeck and back. (For such a flight to count as a record, it had to be declared fully before take off.) The performance was carefully measured in flight. The best glide ratio was 1:37.6, a figure which was not exceeded until the advent of new, low drag aerofoil sections.

Regarded, rightly, as an 'orchid', the D - 30 was not a very practical sailplane for the rather irregular terrain of the Wasserkuppe and was never really intended for the rather 'rough and tumble' conditions prevailing in competitions. The D - 30 was badly damaged in a bungee launching accident on the Wasserkuppe. Flinsch was lucky to escape without serious injury.

The D - 30 was rebuilt, with an improved shape for the fuselage pod. Flinsch in June 1939 made a 406 km flight in it after the repairs. Controversy and doubt surrounds its eventual fate. Most probably it was destroyed, as, under orders from above, most German sailplanes were when the Allied forces occupied the country in 1945. It is certain only that it did not survive. A two seat version, the D - 31, was planned but never completed.



Darmstadt D - 30 B Cirrus
1938

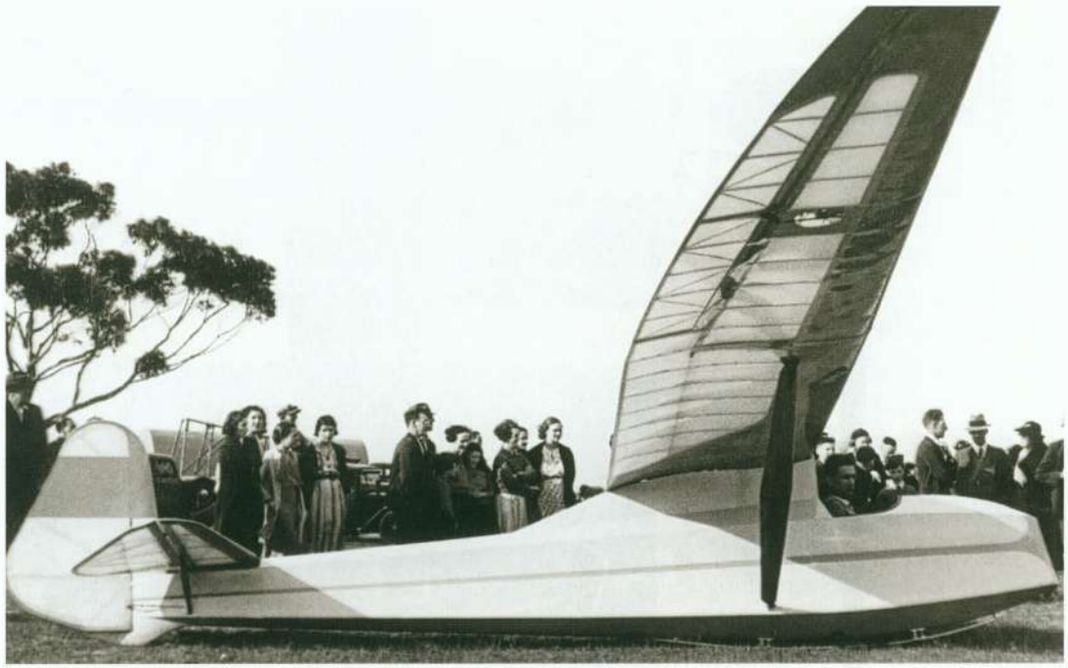
Drawn by Martin Simons 2000 ©

CHAPTER 13

Australia

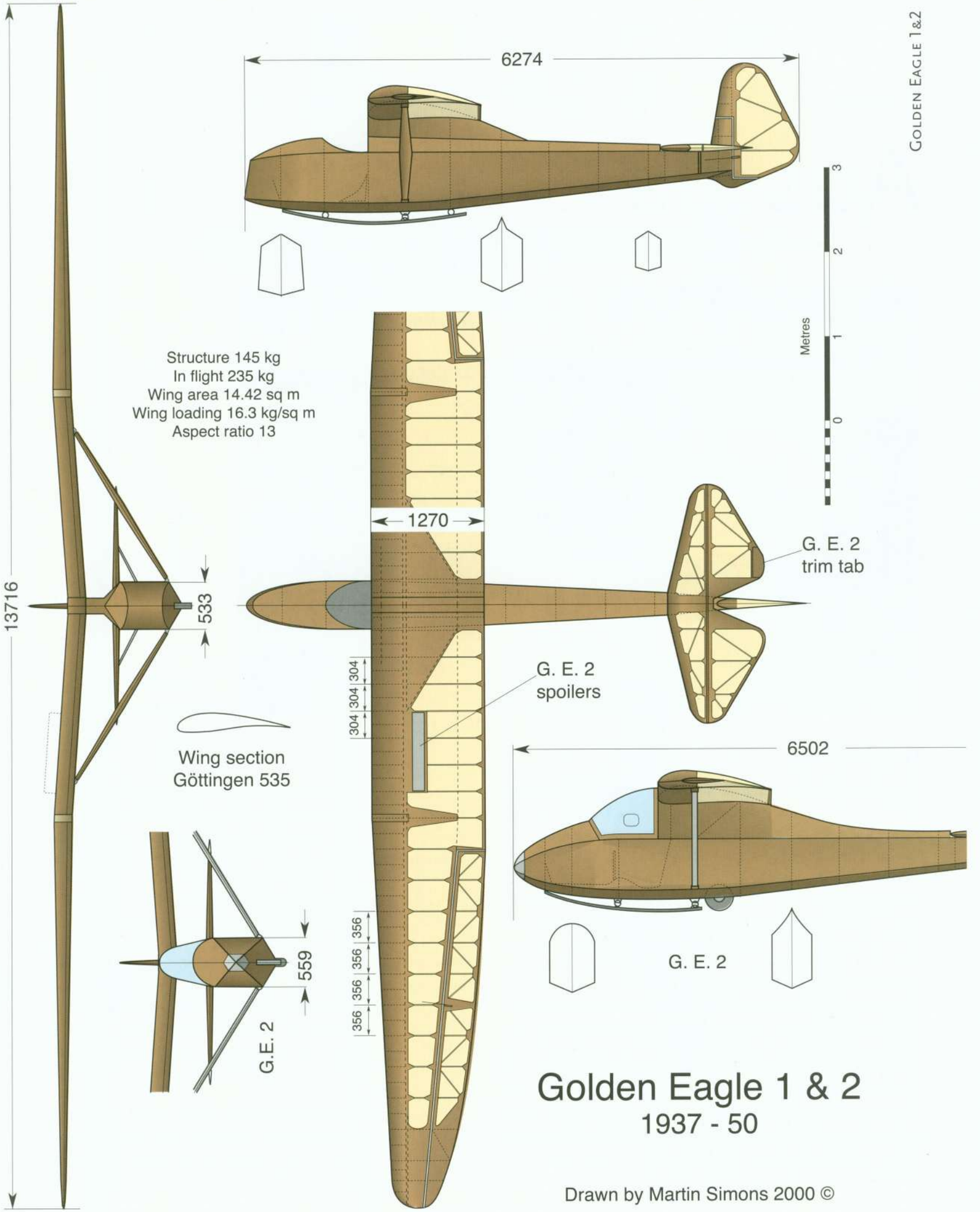
Golden Eagle

In Australia in the nineteen thirties several gliding clubs were operating. Information about developments overseas could be found only occasionally in imported magazines. Geoff Richardson, a Melbourne boy in his teens, began construction of a sailplane in 1934 but after attending a gliding meeting in New South Wales and some further reading, scrapped his original plans and began work on a new design. His Golden Eagle, built at home using casein glue he made himself from a Swiss recipe, flew in September 1937, on the same day and at the same site as the first Grunau Baby 2 to be imported to Australia. Although in some respects resembling the prototype Grunau Baby, The Golden Eagle was an entirely original design, having a similar performance. In 1950 the front fuselage was rebuilt with an enclosed canopy and landing wheel. Spoilers and a trim tab for the elevator were added. In this form the Golden Eagle remains in service, still held together safely by the same, home made, glue.



Above: In its original form the wing was mounted high on a narrow pylon, with open cockpit.

Below: The Golden Eagle was designed and built in Australia by Geoff Richardson in 1937, after seeing reports of German gliders in a magazine.



Golden Eagle 1 & 2
1937 - 50

CHAPTER 14

Austria

Kronfeld's Austria II. Cabin with door under the wing.

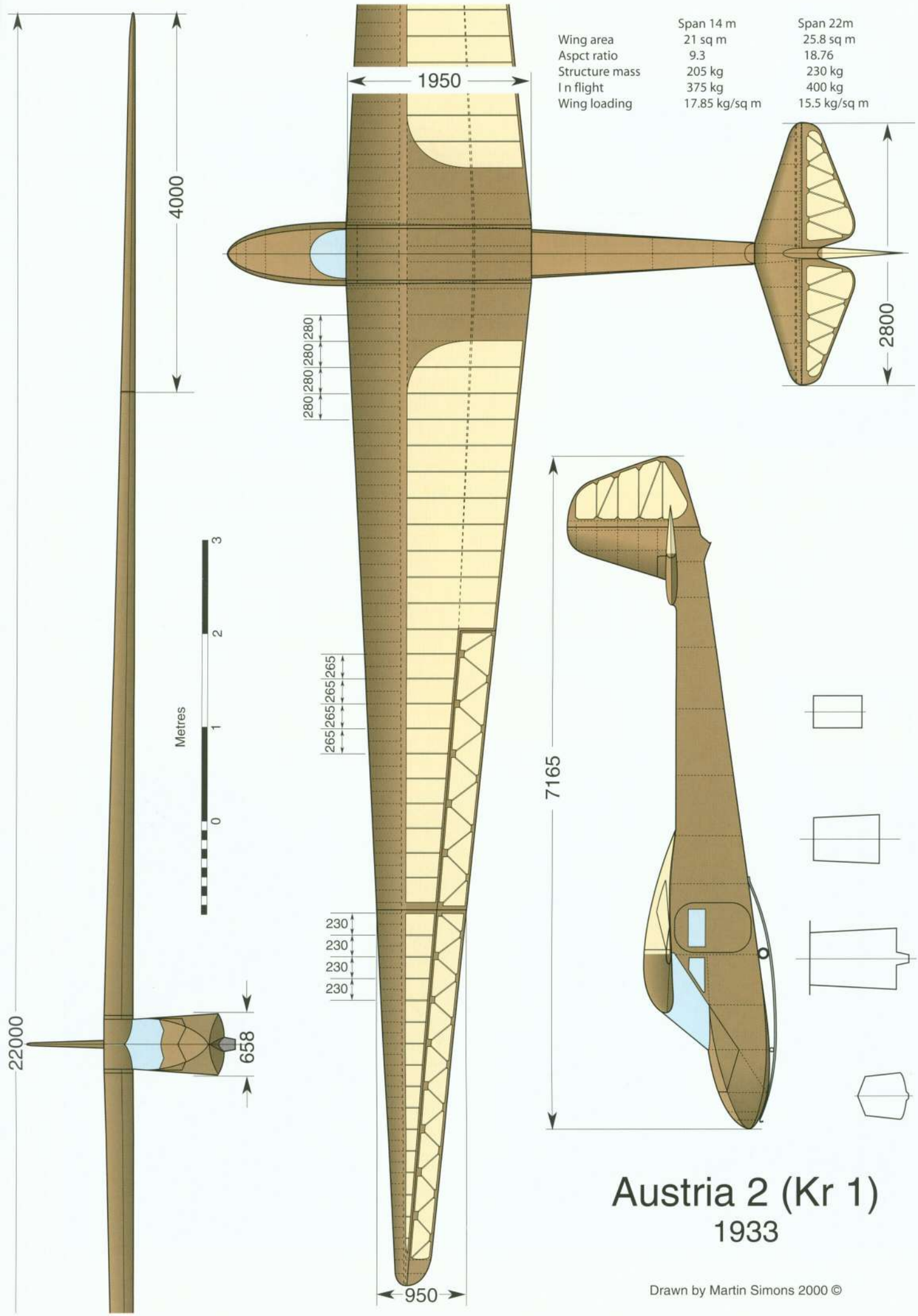
Austria 2 and 3

The very large two seat sailplane Austria 2 was designed by Dr Küpper in Munich, to the specification of Robert Kronfeld. On the plans it was described as the Kr 1, presumably short for Kronfeld 1. Parts of it were displayed at the Rhön in 1932 and the first flights were made in the autumn of the same year. It seems to have been intended from the first as a passenger carrier. Behind the fully enclosed cockpit was a cabin with a hinged entry door with an oval window. The rear cabin was described by an English observer as 'dim'. There were no dual controls. The structure was orthodox.

The most unusual feature other than sheer size was that the outer wings, each 4 metres long, could be removed to permit flight with a span of only 14 metres. In this configuration Kronfeld, flying solo, did aerobatics. More extraordinary still, the outer sections could be housed entirely inside the inner wings. Ahead of the main spar, inboard, was a padded tunnel into which the outer ailerons, removed from their hinges, could be slipped. Behind the spar was a similar housing into which the tips, less ailerons, went. It was then possible to re-assemble the sailplane with the 14 metre span wing and fly it normally.

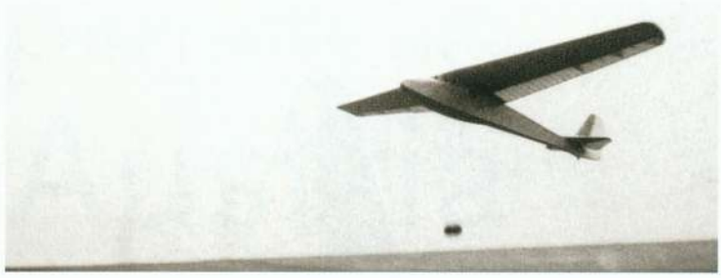
The reason for this unusual arrangement was that Kronfeld intended to use the sailplane for displays and tours to publicise the sport of soaring. The Austria 2 was aero towed, with wings inside wings, from city to city, landed, re-rigged, gave its displays, carried its influential passengers, was disassembled, wings put inside the wings again, towed to the next place, re-rigged, flown, and so on. In January 1933 the Austria 2, parked on the airfield at Semmering, was badly damaged in a wind storm but was repaired. Kronfeld demonstrated his aircraft very widely throughout Europe during 1933, visiting Vienna, Naples several times (he soared over Vesuvius), Rome, Milan, Turin, St Quentin, Frankfurt, Budapest, Graz, Salzburg, Paris, Strasbourg, Rennes and other places. Finally the Austria 2 was taken to Cairo at the time of the FAI Congress. There it was sold, to be re-christened the Fasold. It was reported to be still in operation in 1937.

Meanwhile Kronfeld had bought the Kr 1a, Austria 3 ,which was similar in all respects although, doubtless, there were minor improvements. He was already flying this in August 1933 at the Bannes d'Ordanche meeting in France, competed again at Vin-



Austria 2 (Kr 1)
1933

Drawn by Martin Simons 2000 ©



The only known photographs of the Austria 3 flying in England with the short wing.

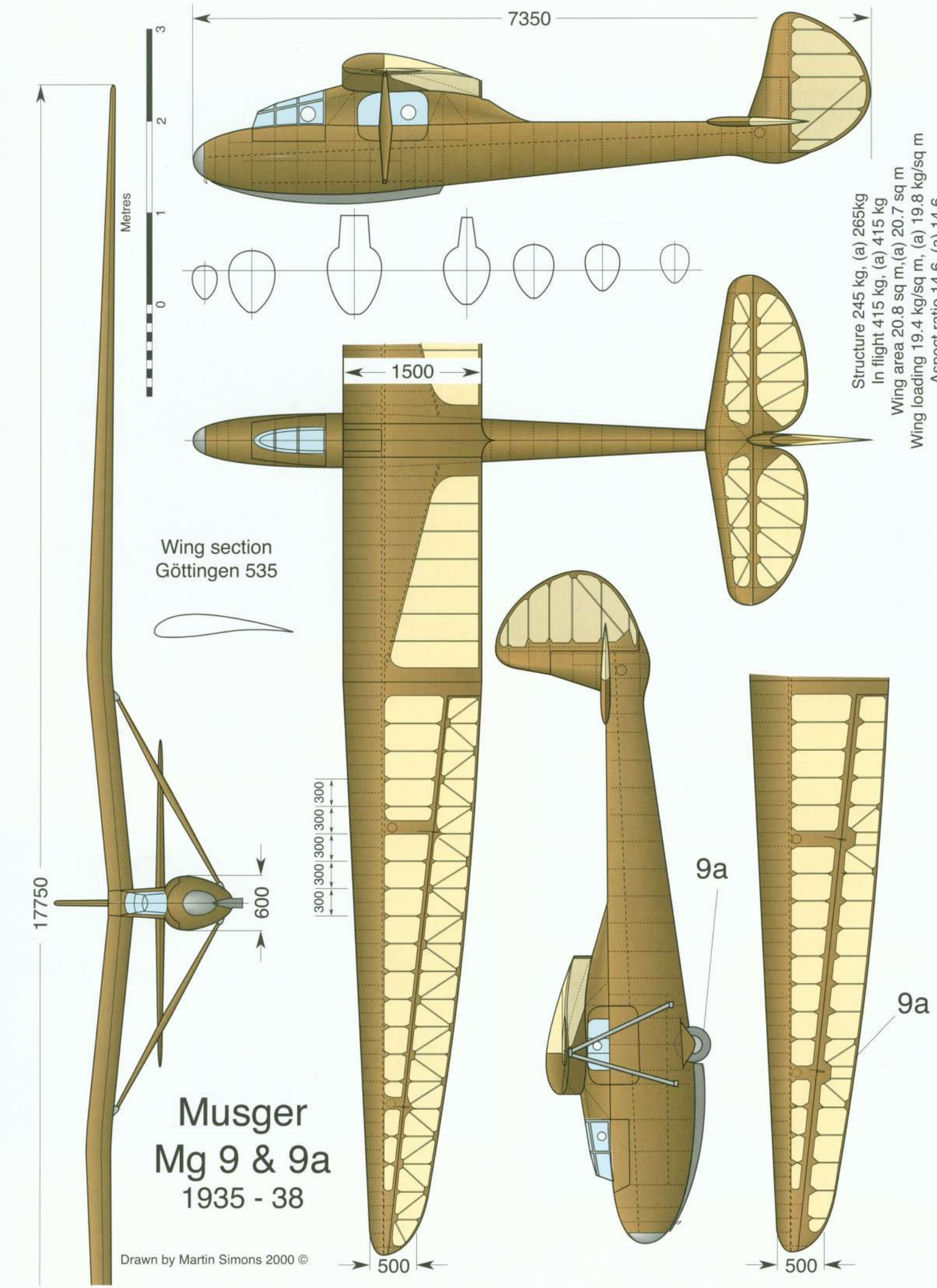
cennes in May and put on an aerobatic display at Le Bourget. On June 11th, during an aero tow to Limoges, the tug engine caught fire. After release both aircraft landed safely. The tug pilot escaped as the aeroplane burned and finally exploded. Still in France, in July 1934 Kronfeld received the Grand Prix du Puy-de-Dome. After this, he settled in England. He took the Austria 3 with him and it was flown at the Southdown gliding club site near Itford Hill. After this it did not fly again and what became of it is not known.

Musger MG - 9

The engineer Erwin Musger designed his first high performance sailplane, the Mg - 1, in 1932. Further designs included both sailplanes and light aeroplanes and in 1936 he developed the two seat, dual controlled Mg 9, the prototype being formally christened OE - Kamerad. It was intended for training and performance flying and was stressed for aerobatics.

The second seat was under the high wing, which had gull dihedral and single struts. The undercarriage was a simple skid. It proved successful and was developed further to produce the Mg 9a. The front cockpit was enlarged and a landing wheel was added. The struts were divided to make an inverted V, joining the fuselage frames at two points behind and in front of the wheel, but with only one attachment point to the wing main spar. Production of ten of the MG 9a was undertaken, most of them having an Austrian OE - registration with the name of a planet after the dash, OE - Merkur, Mars, Venus, etc. A few more were built after this.

The Musger MG 9 at the 1936 ISTUS meeting.


7350
Metres
0
1
2
3
1500
17750
600
300
300
300
300
300
Wing section
Göttingen 535
9a
9a
500
500
Structure 245 kg, (a) 265kg
In flight 415 kg, (a) 415 kg
Wing area 20.8 sq m,(a) 20.7 sq m
Wing loading 19.4 kg/sq m, (a) 19.8 kg/sq m
Aspect ratio 14.6, (a) 14.6
Musger
Mg 9 & 9a
1935 - 38
Drawn by Martin Simons 2000 ©

The pilot Toni Kahlbacher used the Mg 9a to break many Austrian records. Also with co - pilots Tauschegg and Josef Führinger on two separate occasions in 1938 he broke the World two seat duration record with flights respectively over 23 hours and 40 hours. The prototype MG 9 and the Mg 9a OE - DUO were taken to the ISTUS meeting in Salzburg in 1937. At the Rhön competition in 1938, flown by Toni Kahlbacher and Tauschegg, the Mg 9a did very well in the two seater contest, placing third in a field mostly of Kranichs.

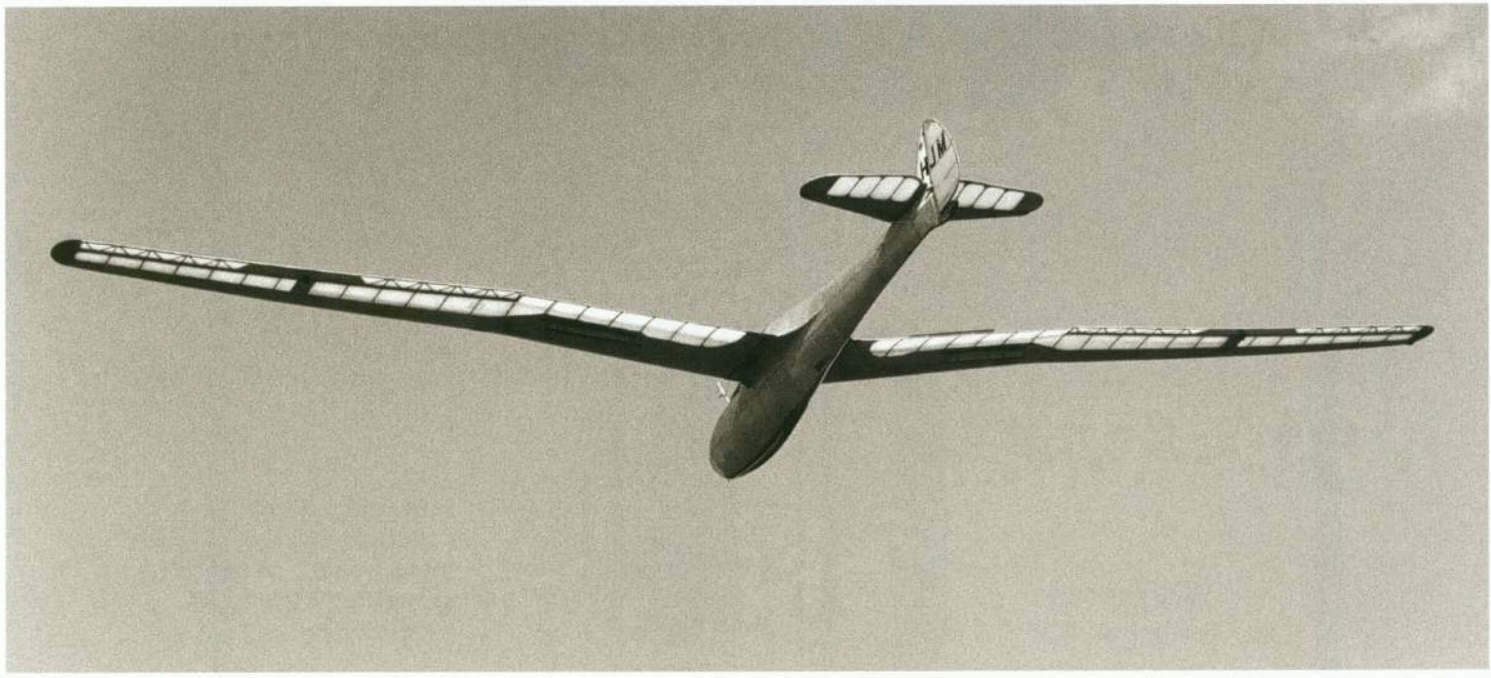
Musger continued to design sailplanes, the very successful Mg 19, 19a, b and c series of two seaters beginning in 1951, to the MG 23 which continued in production till 1966.

Above: The Mg 9a, with wheel and inverted V struts. Austrian markings after the Anschluss.

Below: The Hütter 17 at Dunstable.

The Hütters

For flying in the Austrian Alps, the brothers Wolfgang and Ulrich Hütter of Salzburg designed a small, 10 metre span single seat sailplane which they expected to achieve a glide ratio of 17:1. Hence it was named the Hütter 17 or H - 17. It resembled a small Grunau Baby, with high wing of Gö 535 profile, strut braced, above a hexagonal box fuselage with open cockpit. However, the ailerons were slotted to ensure good response at all times and everything possible was done for easy building.



As soon as the prototype had been proved satisfactory, plans were published and about a dozen sets were sold quickly. After this, the Hütters joined the Schempp - Hirth Company in Göppingen, as designers. The H - 17 became the Göppingen 5. A landing wheel and canopy, with a windscreen, were added. A few were built in the factory and many more plans were sold.

After World War 2, production at Göppingen resumed and the H - 17B was developed, with a fully enclosed canopy, longer fuselage, air brakes and other modifications. More plans were sold.

How many of the H - 17 were completed and flown over the years is not known but in England at least two more have been built in recent years and there remain others in service throughout the world. The H - 17 will soar well once it is in lift but reaching the next thermal after a climb is not easy. The glide ratio probably does not reach 17.

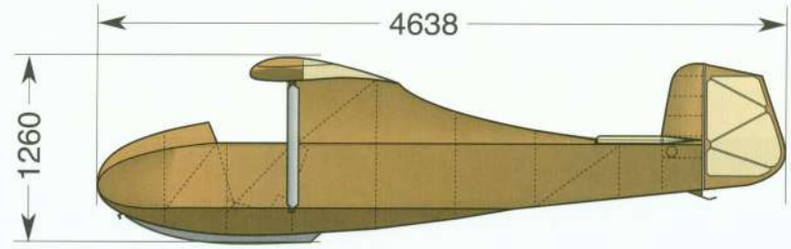
Still believing that sailplanes should be small, but recognising that their little H - 17 did not satisfy ambitious pilots, the Hütters went on to develop a high performance sailplane which they calculated would have a glide ratio of 28:1, hence, the H - 28. Great ingenuity went into the 12 metre span design. A special feature was the large one-piece moulded transparent canopy, specially produced at the Darmstadt Technical University where plastics were being actively studied. On this prototype the wings were straight although gull wings had been intended originally. Flight tests were satisfactory but the measured glide ratio was found to be a somewhat disappointing 23.4.

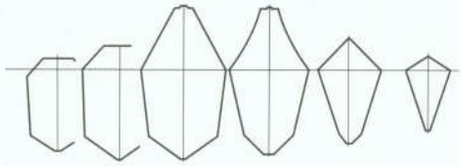
The H - 28 II had gull wings and a canopy built up from separate pieces of plastic. A single H - 28 III was built, in Denmark, which had an improved glide ratio of 27.2. One replica H - 28 was built and flown by Earle Duffin in more recent years, in England. This did not follow the original design exactly.

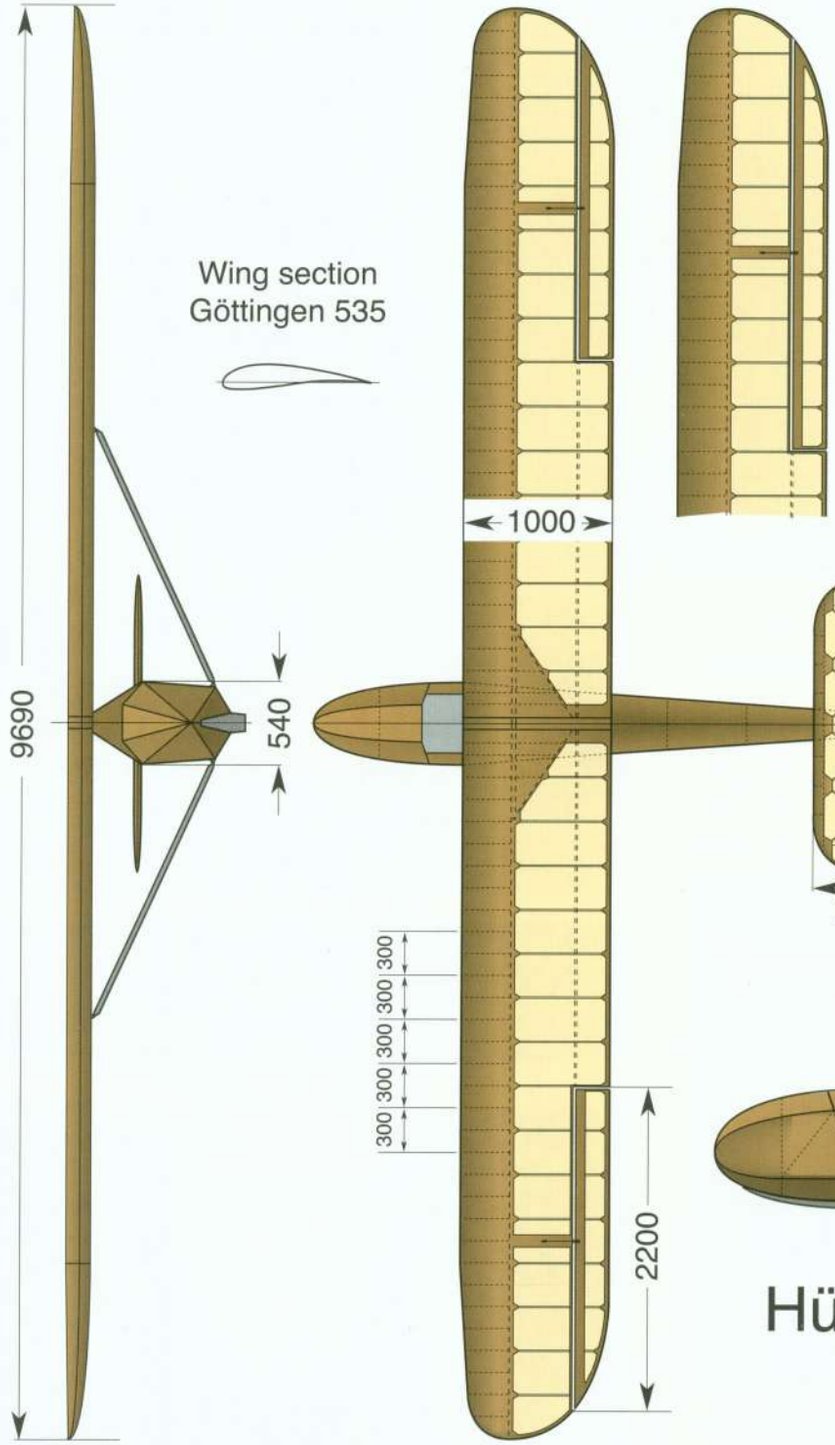
Above: The Hütter 28 replica by Earle Duffin.

Middle: The Hütter 28 II in 1974, flown by Herr Aeberle of Switzerland.

Below: The wing roots gave the pilot elbow room.

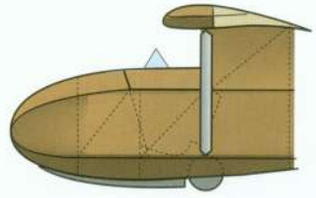






Wing section
Göttingen 535

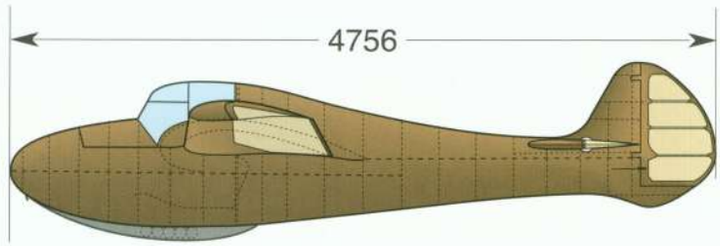
Structure 65 kg
In flight 158 kg
Wing area 9.2 sq m
Wing loading 17.2 kg/sq m
Aspect ratio 10.2

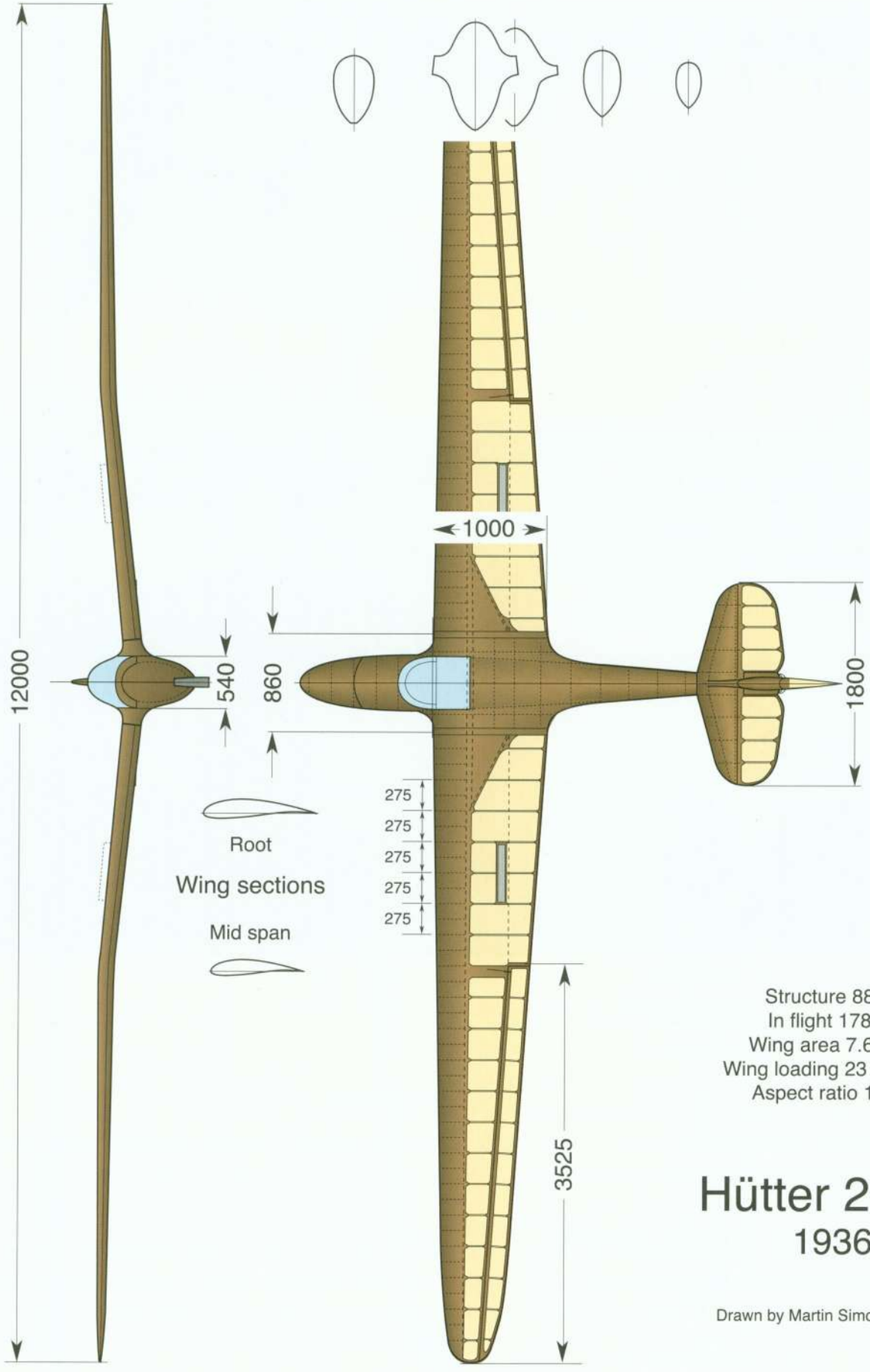


H - 17 B

Hütter H - 17

(Göppingen 5)
1934





Structure 88 kg
In flight 178 kg
Wing area 7.6sq m
Wing loading 23 kg/sq m
Aspect ratio 18.46

Hütter 28 - II
1936

CHAPTER 15

Britain

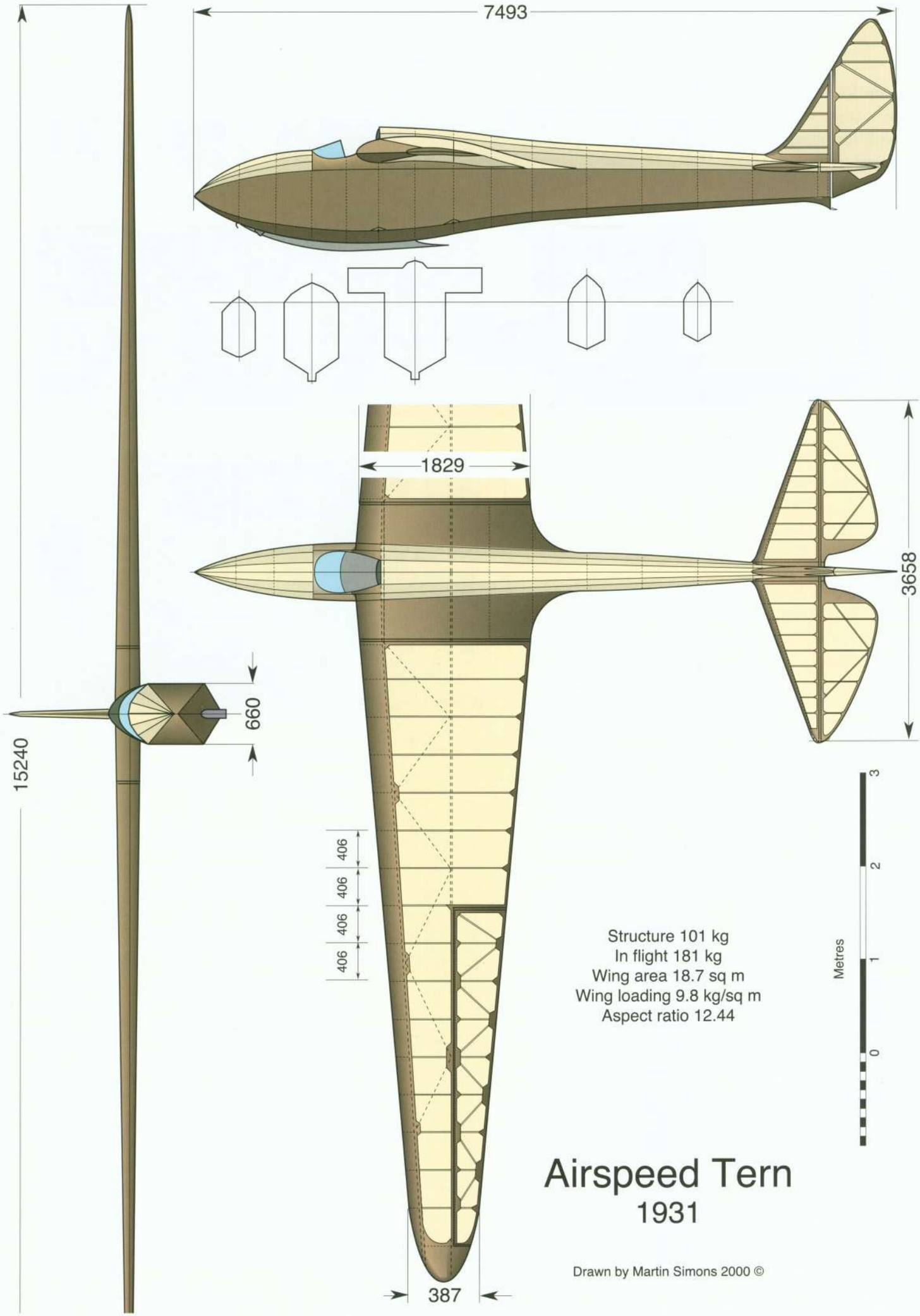
The Tern soaring

Major Petre in the Tern cockpit at Balsdean on the South Downs in 1931

The gliding movement in Britain, following a false start with the Itford meeting in 1922, began after a preliminary gathering in December 1929, with the formation of the British Gliding Association. There was no government interest, and nothing in any British University or college like the German Academic flying groups. Where something of the sort did exist, for example at the De Havilland Technical School from 1928, the chief preoccupation was with racing aircraft. British gliding therefore had to be self supporting. A subsidy was granted to the BGA in 1935 but it amounted to only £5000 annually for a few years.

Airspeed Tern

The Airspeed Company, founded in England in 1930 by Hessell Tiltman and Neville Shute Norway (later famous as a novelist) urgently needed a product to sell. The sudden interest in soaring stimulated by developments in Germany, suggested that an inexpensive sailplane would find a ready market. Tiltman was an aeroplane designer who turned briefly to gliders. The Airspeed Tern, first flown in 1931, had a fabric covered, two spar, tapered cantilever wing without dihedral. The plywood leading edge was only a fairing,



Structure 101 kg
In flight 181 kg
Wing area 18.7 sq m
Wing loading 9.8 kg/sq m
Aspect ratio 12.44

Airspeed Tern
1931

playing no structural role. The fuselage was a three sided plywood box with the upper decking, like many contemporary aeroplanes, fabric covered. The cockpit was generous in both depth and width, which may have been comfortable but did not reduce drag to the minimum.

At the time there was nothing comparable available from any British manufacturer. The Tern had some success, but only one was completed by Airspeeds. Parts for the second were sold but it was never finished. The original Tern was reconstructed, using the prototype and parts from the second example, in post war years, but little was done with it.

Above: The Scud 2, light and compact, first marketed in 1932

Below: The author in the Scud 2 cockpit. A struggle to get in.

The Scuds

L. E. Jeffrey - Baynes was a talented engineer who had been involved with the aircraft industry since 1916. In designing the original Scud his approach was quite radical. It should be possible to produce a cheap sailplane which, if not capable of the highest possible performances, would at least give the pilot a lot of pleasure in safety. The 7.7 metre span Scud was advertised in 1931 and buyers were found for about five. Plans were sold to amateur builders. The fuselage, of diamond shaped cross section, was suspended below the small, one piece wing on struts. For the pilot to get into the cockpit was a considerable struggle. The wing was of low aspect ratio and approximately rectangular in plan, but the tips were tapered to reduce vortex drag a little. The plywood skin was required to carry a full share of the torsional loads. The all - moving tail members were interchangeable, the rudder could be used for one of the elevators and vice versa.

In flight the Scud proved very sensitive and required a delicate touch. Edward Mole, an RAF officer and pilot, succeeded in soaring a Scud for an hour and was happy to be quoted in advertisements. Inexperienced pilots tended to over control and there were accidents. In Australia a Scud was burned after a very few trial flights, when the owner-builder decided it was too dangerous for anyone to fly.

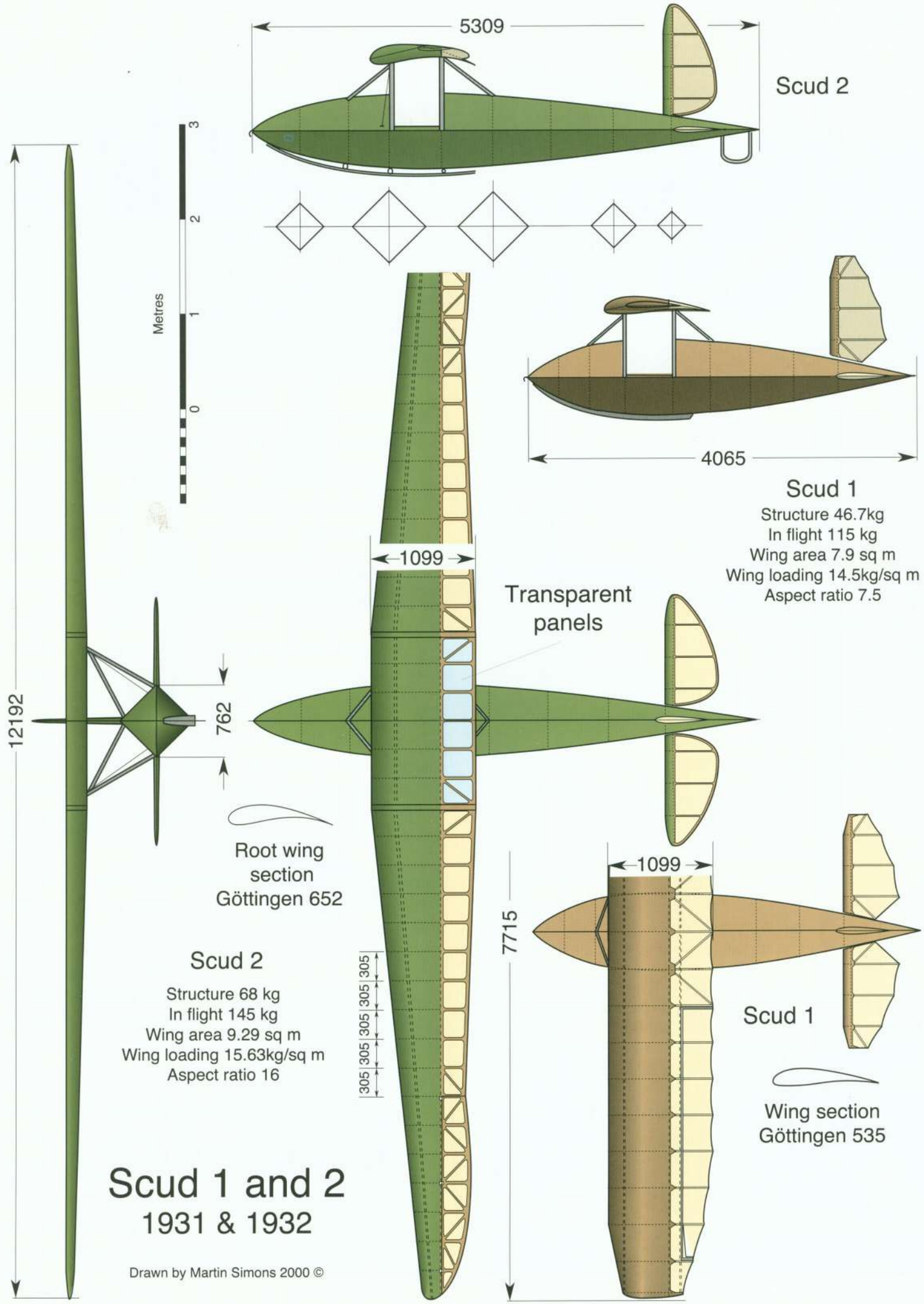
Baynes designed the Scud 2, which proved very much more successful. The fuselage was slightly lengthened without increasing the cross sectional area. The wing was extended to over 12 metres span with the currently popular Gö 652 profile and aspect ratio of 16. There was a rectangular centre section with the outer panels easily detachable for transport. The structure weight was only 30 kg more than the first Scud. Getting into the cockpit was no easier but transparent panels in the rear wing covering gave a slight improvement to the upward view.

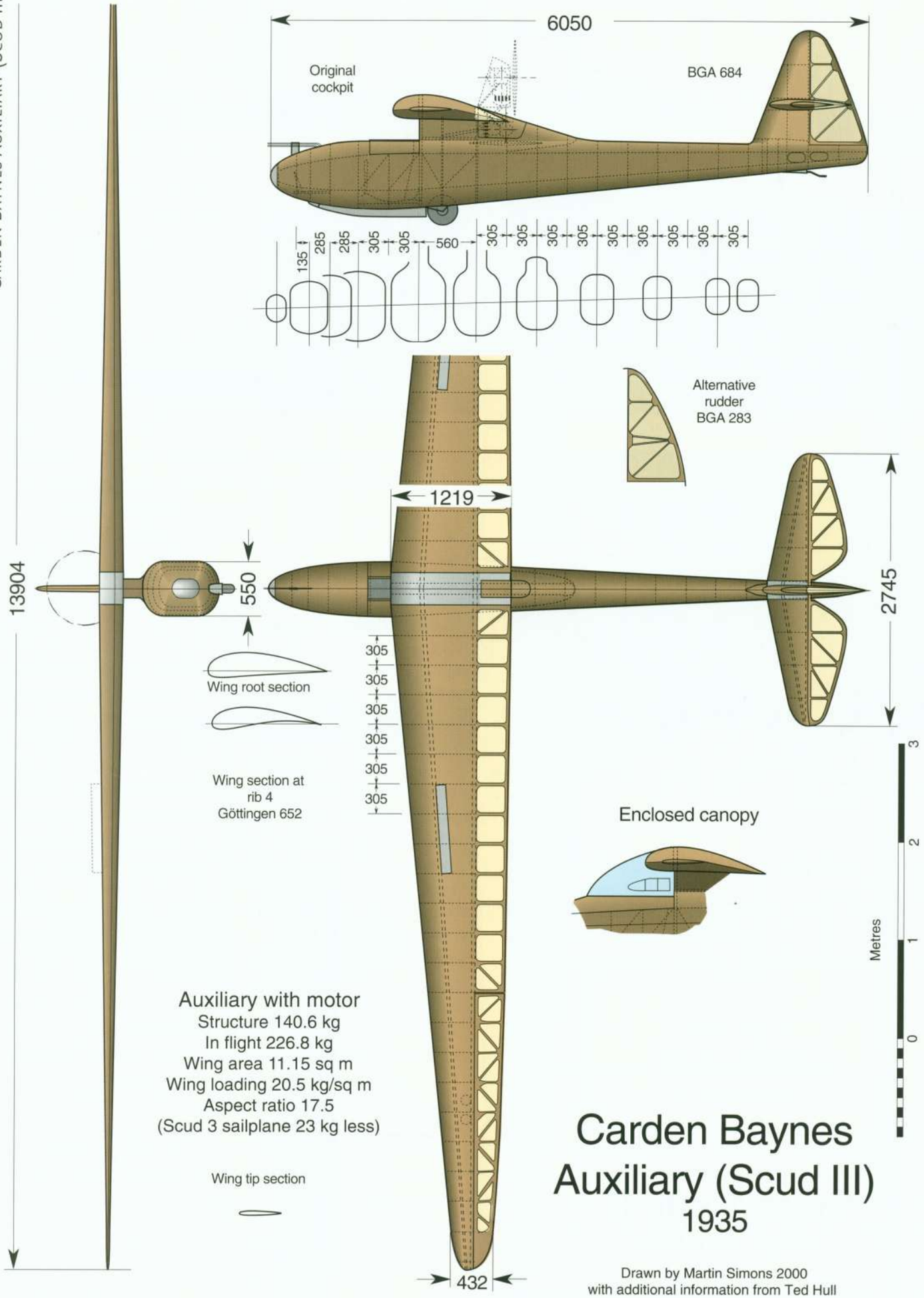
Four of the Scud 2 were completed and sold. One had a lengthened nose to accommodate the tall pilot, Philip Wills. Mungo Buxton, an RAF officer, broke the British height record in this aircraft with a climb in cloud to 2537 metres.

One Scud 2 survived to fly after World War 2 and this aircraft, fully restored, is still extant and airworthy.

Carden Baynes Auxiliary, Scud 3

Baynes foresaw that eventually sailplanes would be fitted with motors, equivalent to the outboard motors of yachts, to get them into the air without helpers, and to fly home after a cross country soaring flight. With the offer of financial support and an order from Sir John Carden he designed the Scud 3 or Carden Baynes Auxiliary. The tapered wing was similar to the Scud 2 but of slightly more span. The root section was simplified but changed rapidly to the Gö 652 profile, then to a symmetrical tip. The fuselage frames were rectangular with rounded corners, a good compromise between sim-


5309
Scud 2
Metres
3
2
1
0
4065
Scud 1
Structure 46.7kg
In flight 115 kg
Wing area 7.9 sq m
Wing loading 14.5kg/sq m
Aspect ratio 7.5
1099
Transparent panels
12192
762
Root wing section Göttingen 652
Scud 2
Structure 68 kg
In flight 145 kg
Wing area 9.29 sq m
Wing loading 15.63kg/sq m
Aspect ratio 16
305
305
305
305
305
7715
1099
Scud 1
Wing section Göttingen 535
Scud 1 and 2
1931 & 1932
Drawn by Martin Simons 2000 ©



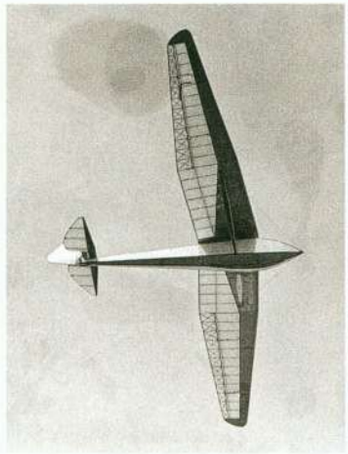
Carden Baynes Auxiliary (Scud III)
1935

Drawn by Martin Simons 2000
with additional information from Ted Hull

plicity and the a fully rounded form. The wing was mounted high on a streamlined pylon behind the cockpit. In a special compartment behind the main fuselage frame was the power unit. The small, 9 PS 250 cc engine, with its propeller, could be raised above the wing to allow the sailplane to take off under power and climb to soaring height. Then it was fully retracted. Fuel for about 30 minutes was allowed. To make operations as simple as possible, a throttle operating cable was run through the wing to a handle at the tip. The pilot, having started the motor by swinging the propeller, could then walk to the wing tip, control the throttle and taxi the aircraft to any suitable point, get into the cockpit and take off.

It all worked quite well. The Auxiliary could and did launch itself from suitably smooth airfields, and climbed away without any problems, though slowly. To operate from rough surfaces was not so easy. The motor was, after some few trials and an accident caused by turbulent air soon after take off, deemed too small for practical operations. Carden himself was killed in an airliner accident and never took delivery of his Auxiliary. Baynes removed the motor and sold the repaired Scud 3 as a sailplane. One more was built, without an engine.

Baynes was ahead of his time but, like many others, he over estimated the likely demand for sailplanes in Britain in the 'thirties. Had there been a better market, with a slightly more powerful motor and a few related minor changes, the Auxiliary might have been a highly successful self launching sailplane. The original motor was for many years exhibited in the Science Museum in London, as the smallest power unit ever to get an aeroplane into the air and sustain flight.



Both Scud 3s survive. They are operated regularly, as sailplanes, and are popular with their pilots. Built in 1934, they are probably the oldest sailplanes still in operation.

Above: The Scud 3. Both survive and are still flying.

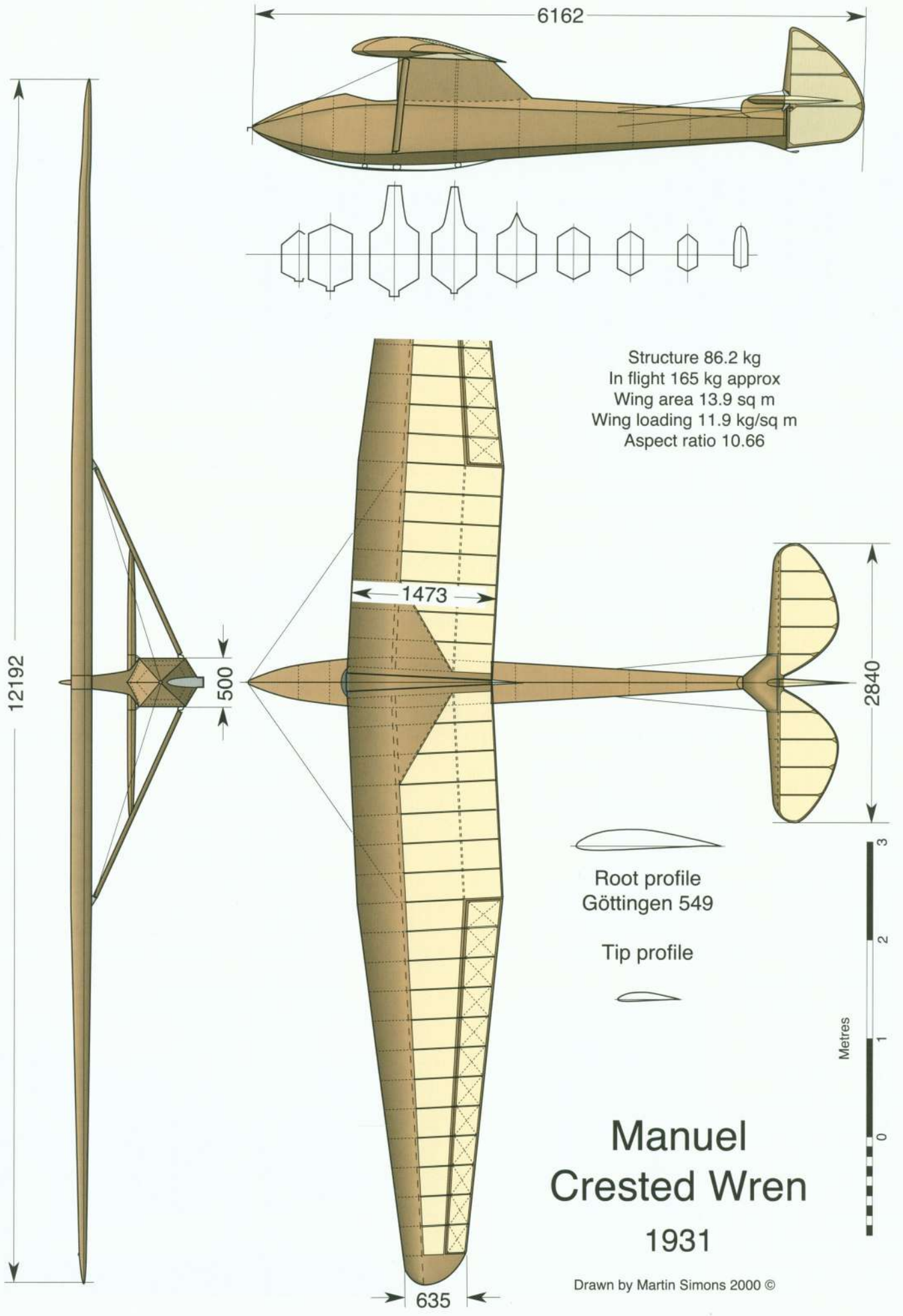
Left below: The Willow Wren, flown in 1932 in England and built from plans by amateurs in Britain, Australia and New Zealand.

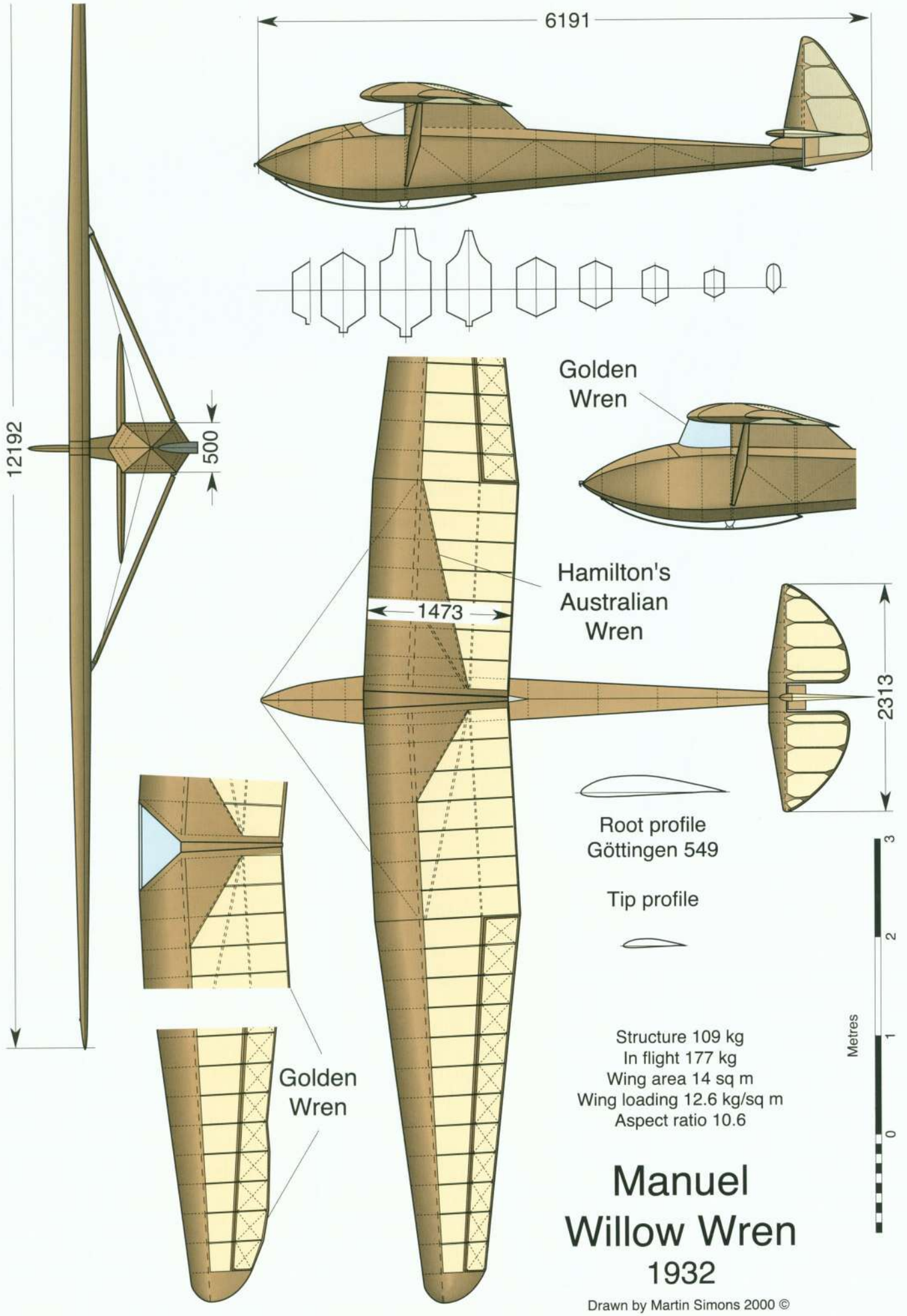
Right below: The Willow Wren, restored.

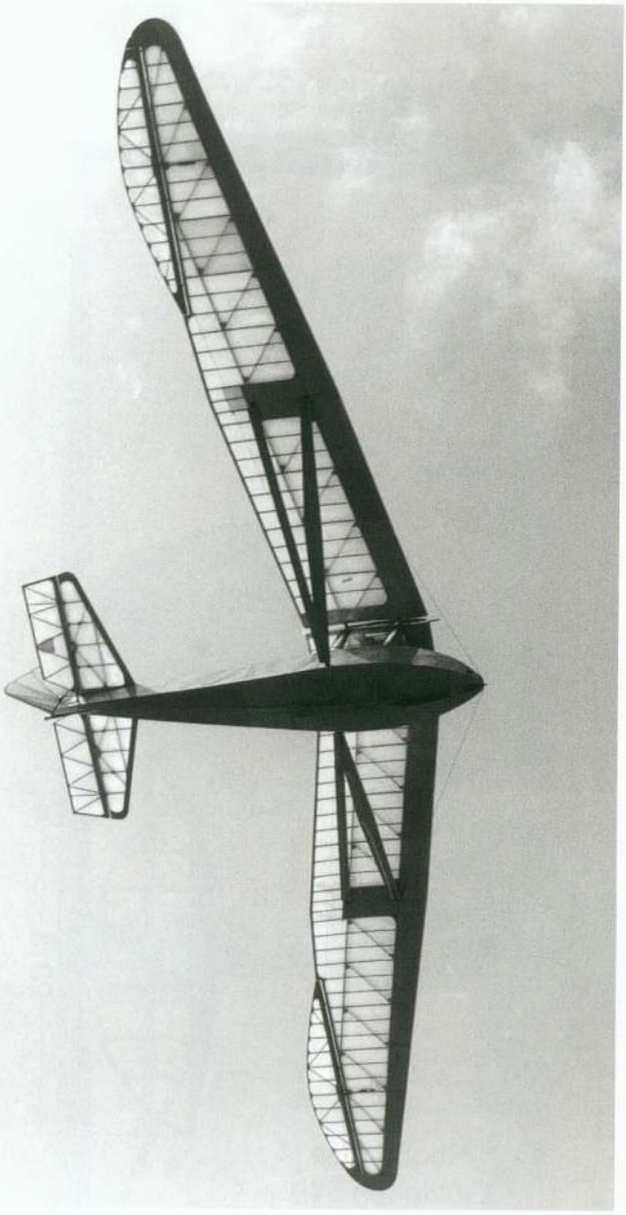
The Wrens

Bill Manuel was a corporal in the RAF in 1930 when he became fascinated by soaring and decided to design and build his own small sailplane. With limited tools, money and workshop space, he produced the Crested Wren, 12.2 metres span. It was of the simplest possible design and construction and easy to build, yet flew well. Manuel was encouraged to develop it further and sell plans.

He did so, producing in 1932 the Willow Wren which had a deeper fuselage and improved tail surfaces, additional stiffening in the fuselage and wing, and other minor changes. The Blue Wren, completed 1934, had some further redesign of the wing to prevent wing tip stalling at low speeds. Meanwhile, plans had been sold to amateur groups. In England the Golden Wren was built with an enclosed cockpit, and others were built in Australia and New Zealand. At least seven of the Willow Wren type were flown altogether. All flew successfully. The Golden Wren in particular showed itself capable of 'Silver C' cross country and height gain flights, and survived


6162
12192
500
1473
2840
635
Structure 86.2 kg
In flight 165 kg approx
Wing area 13.9 sq m
Wing loading 11.9 kg/sq m
Aspect ratio 10.66
Root profile
Göttingen 549
Tip profile
Metres
0
1
2
3
Manuel
Crested Wren
1931
Drawn by Martin Simons 2000 ©


6191
12192
500
Golden
Wren
Hamilton's
Australian
Wren
1473
2313
Root profile
Göttingen 549
Tip profile
Golden
Wren
Structure 109 kg
In flight 177 kg
Wing area 14 sq m
Wing loading 12.6 kg/sq m
Aspect ratio 10.6
Metres
0
1
2
3
Manuel
Willow Wren
1932
Drawn by Martin Simons 2000 ©



The Falcon III.

into the post World War 2 period to be flown until 1947 when glue failure caused it to be condemned. The original Willow Wren still exists, though not now airworthy.

Manuel in association with the Dunstable Sailplane Company went on to design the Kestrel, which was a Willow Wren with improvements such as a larger cockpit and generally more robust structure. The Company completed only one, but plans were sold. Another was built in England, which crashed fatally in a spinning accident in 1939. Three others were constructed in Australia. These continued in service for some years and although no longer capable of flying, they are still extant. One also was built in the USA but its history is not known.

Manuel , after an interval of decades, in 1986 built a non-flying replica Crested Wren, from memory.

Murray and Fox at the Wasserkuppe in 1937, with the Falcon III, when they broke the duration record.

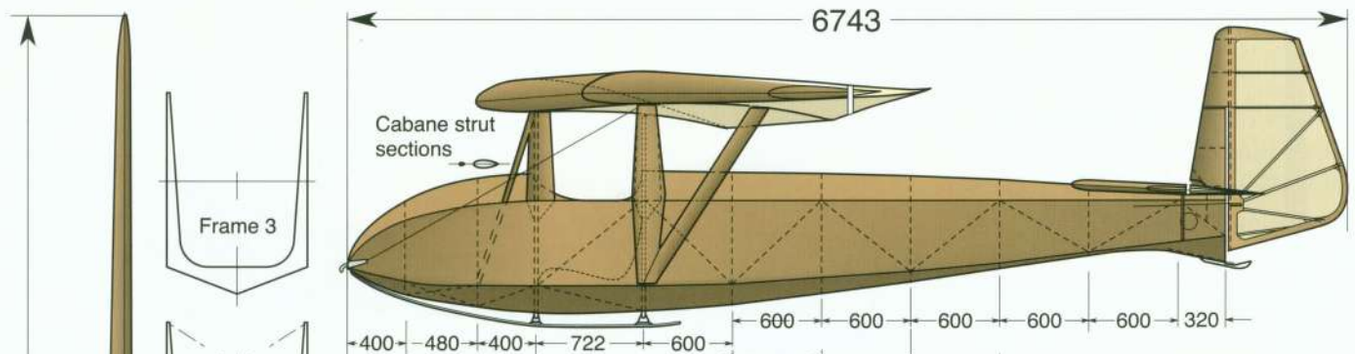
Slingsby Falcon 3

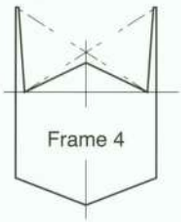
Hardly any two seat sailplanes had been built with side by side seating. For training purposes there are some advantages in the arrangement. Conversation between instructor and pupil is more natural, the instructor can see the student's facial expressions, can point to things outside or inside the cockpit, and both pilots have an adequate view. The only drawbacks are some loss of performance because of the greater frontal area of the fuselage, and if the pupil, or any other pilot, is to fly solo, ballast must be added to bring the balance point to its correct location. Slingsby's Falcon 3, built to the order of Espin Hardwick, a stockbroker, was a two seat version of the original Lippisch Falke. It was popular in England. Nine were built and flown extensively. They were all taken over by the Air Training Corps during the Second World War and only one survived to fly afterwards. This was wrecked in 1947 in a ground looping accident on landing.

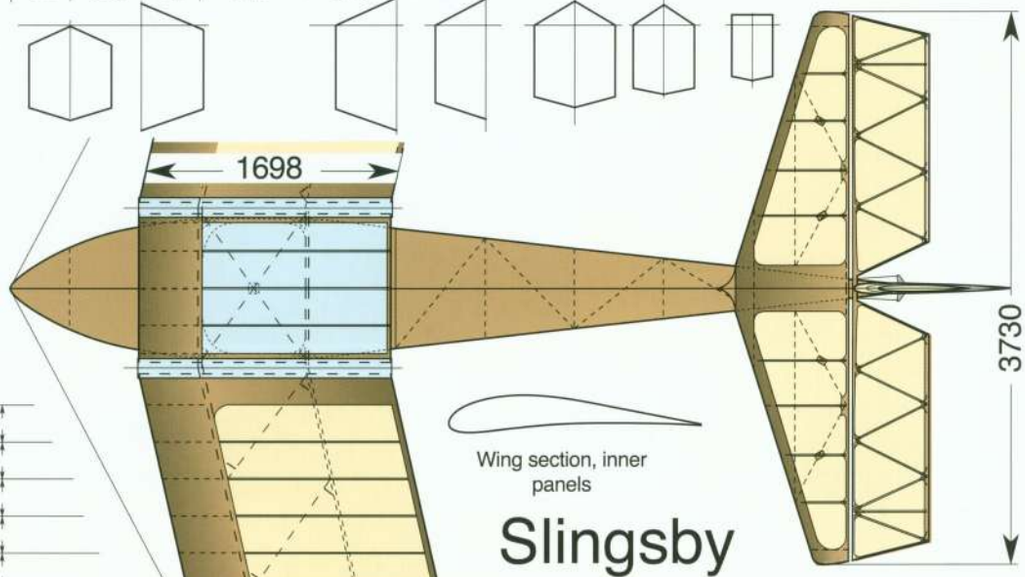
Hjordis

Mungo Buxton was a RAF officer who designed the Hjordis as a private venture, with his friend Philip Wills interested from the beginning as a likely partner and buyer. Buxton was aware of German developments but was not content to copy any existing type. He laid out the wing using the very thick, strongly cambered Göttingen 652 profile at the root, but changed this progressively to the RAF 32 at the tip, in such a way that the wing could be built on a flat surface without elaborate and costly jigging. Plywood skinning was continued back to the light rear spar, with fabric covering the trailing edge.

The fuselage was reduced to a cigar like form of minimal cross section, with a tall and narrow pylon to support the wing. The two vertical main frames were very stout, intended to withstand a ground looped landing. There were no spoilers or brakes.



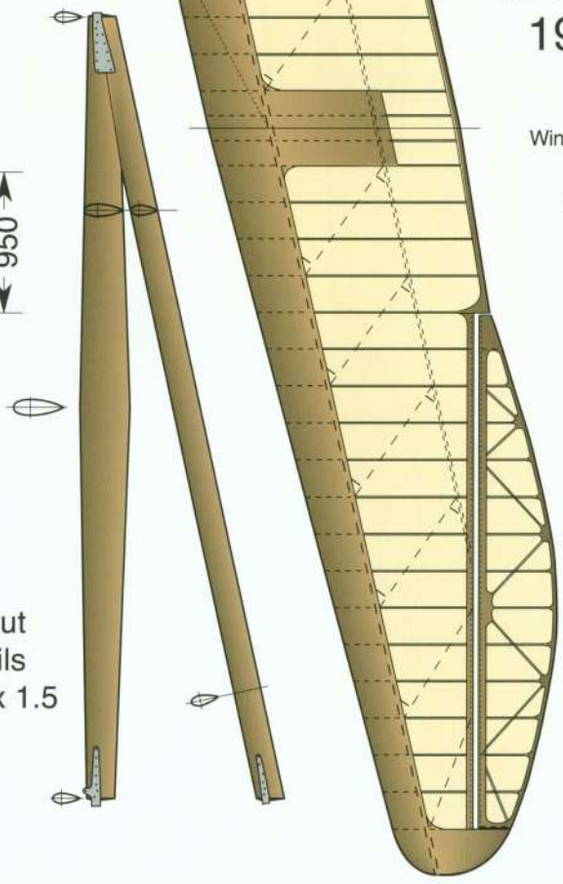




Wing section, inner panels

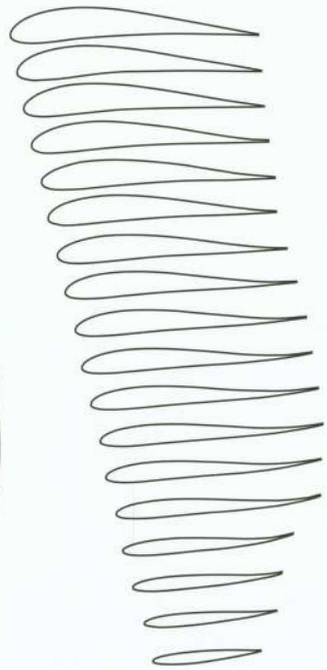
Slingsby Type 4 Falcon 3 1935

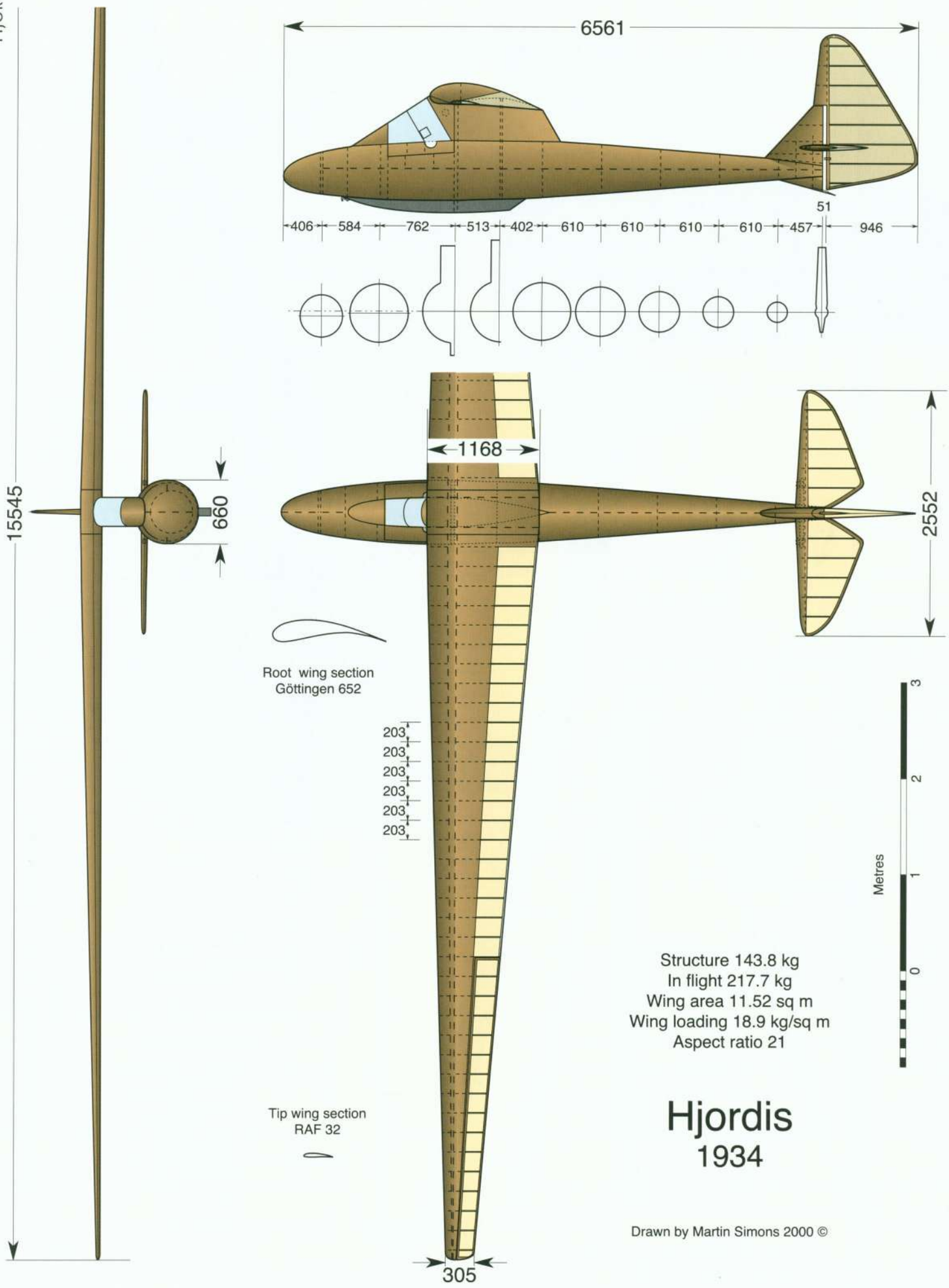
Structure 226.8 kg
In flight 407.5 kg
Wing area 26.5 sq m
Wing loading 15.3 kg/sq m
Aspect ratio 11.8



V strut details Scale x 1.5

Wing sections, outer panels





Structure 143.8 kg
In flight 217.7 kg
Wing area 11.52 sq m
Wing loading 18.9 kg/sq m
Aspect ratio 21

Hjordis
1934

The sailplane was built by Fred Slingsby who was just establishing his business as a sailplane manufacturer. It was flown by Wills at the 1935 British National Competitions and Wills later used it to set British records for distance and height gain, and competed with success again in 1936. The aircraft had many small defects. It was most uncomfortable for a tall pilot. Wills had to cut holes in the cockpit canopy for his shoulders, and the ventilation was very poor. The lack of spoilers ensured that there were many mishaps on landing in small fields. Repairs were often needed.

Nevertheless when the first recognised International Championships were announced in 1937, Wills elected to fly the Hjordis in preference to the King Kite, also designed by Buxton. (For his reasons, see below.) He placed about half way down the field, learned a great deal and sold the Hjordis in 1938 to buy a Minimoa.

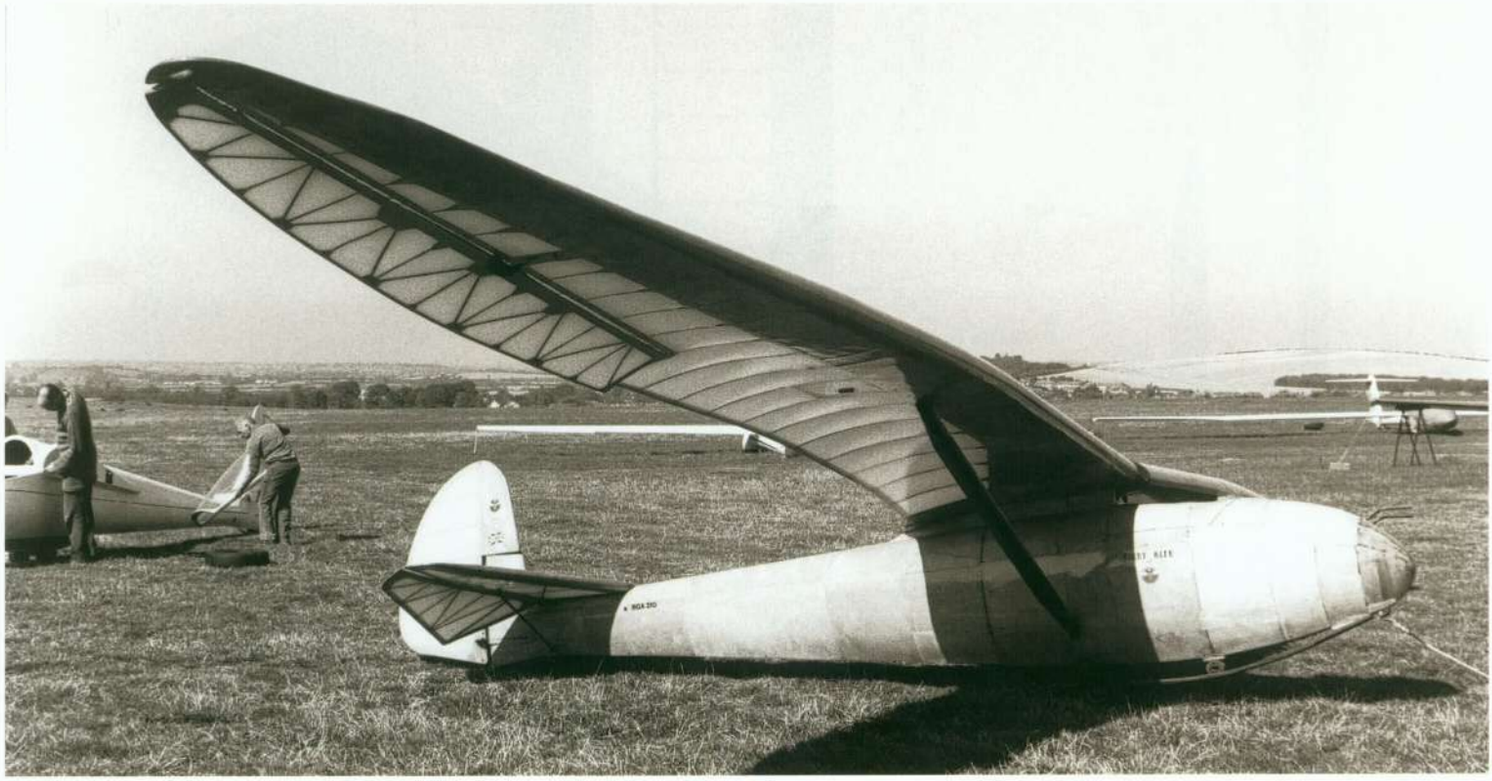
Above: Hjordis launched at the Wasserkuppe Internationals in 1937.

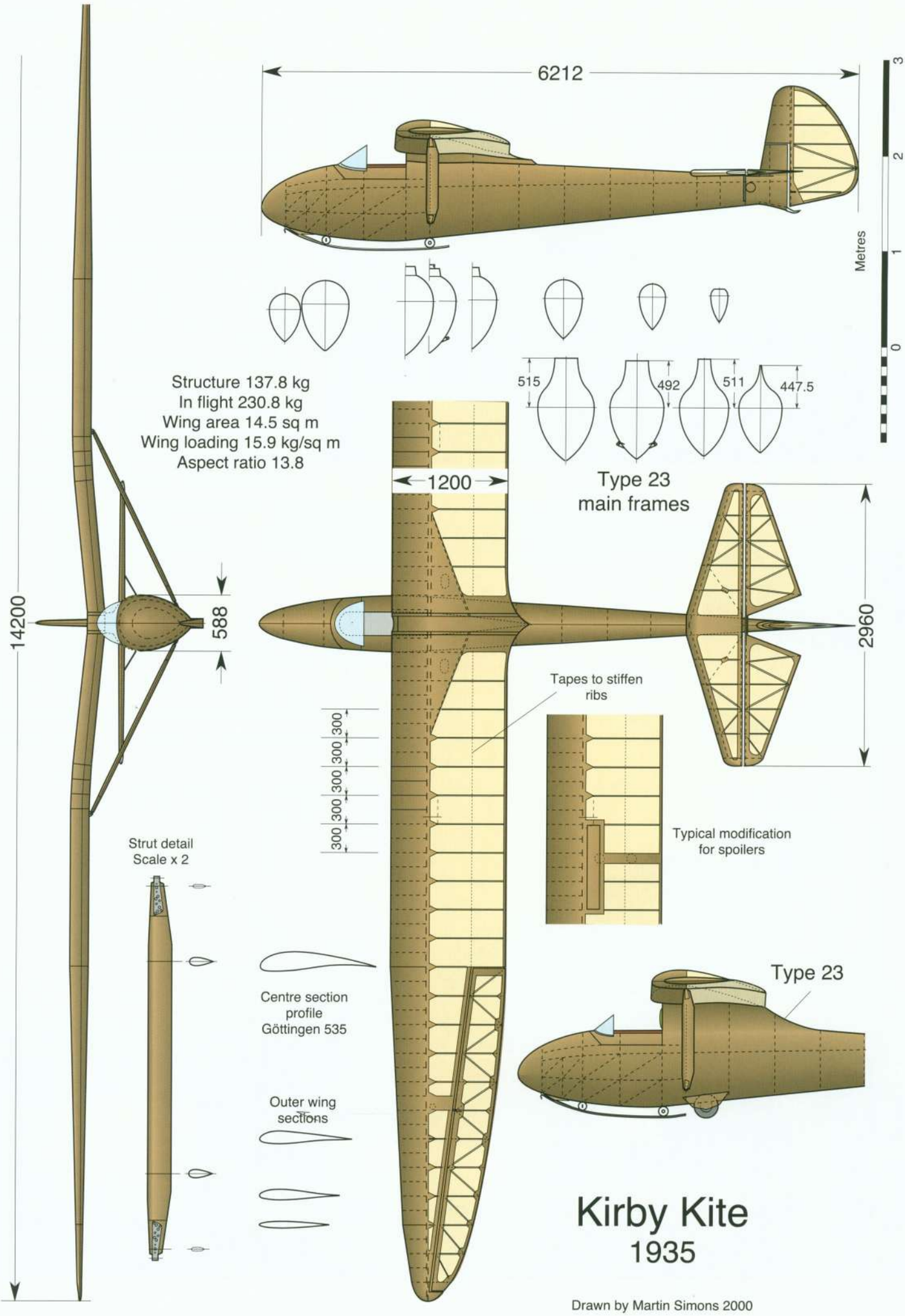
Left: The cockpit of the Hjordis required holes to be cut for the Philip Wills' shoulders.

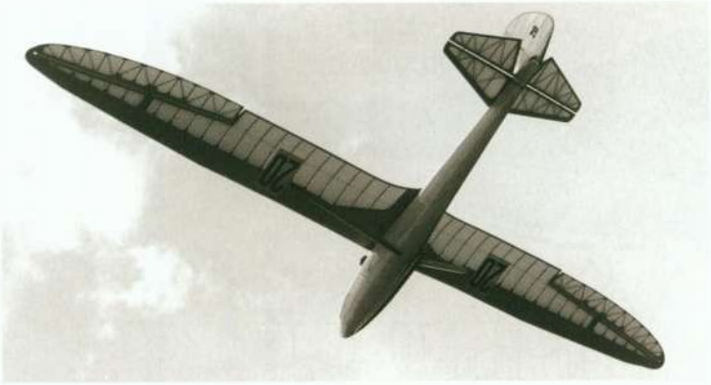
Below: The Slingsby Kirby Kite was not much more than a Grunau Baby 2 wing slightly extended, with a 'gull' form and a more streamlined fuselage.

Kirby Kite

Fred Slingsby built fifteen of the Grunau Baby 2 under licence but in 1935 produced an improved version, the Kirby Kite. The wing was almost the same as the GB, but with span extended by 70 cm and 'gull' dihedral. The hexagonal box fuselage was replaced by a streamlined form and the tail unit had a more elegant shape. The




6212
Metres
0
1
2
3
Structure 137.8 kg
In flight 230.8 kg
Wing area 14.5 sq m
Wing loading 15.9 kg/sq m
Aspect ratio 13.8
515
492
511
447.5
Type 23
main frames
1200
14200
588
2960
Tapes to stiffen
ribs
300
300
300
300
300
300
Typical modification
for spoilers
Strut detail
Scale x 2
Centre section
profile
Göttingen 535
Outer wing
sections
Type 23
Kirby Kite
1935
Drawn by Martin Simons 2000



Kite became popular and twenty five were built, with one constructed from plans in the USA. It was used for cross country flying and competitions.

Four or five remain in service. A further development, Slingsby's Type 23 Kite 1A, appeared in 1945 but only one was built. The Type 26 Kite 2 of 1946 - 7 had a completely different wing and, in competition with the new EON Olympia sailplane, proved a disappointment.

Above: The Kite was popular with British pilots and competed in the National Championships in the late nineteen thirties.

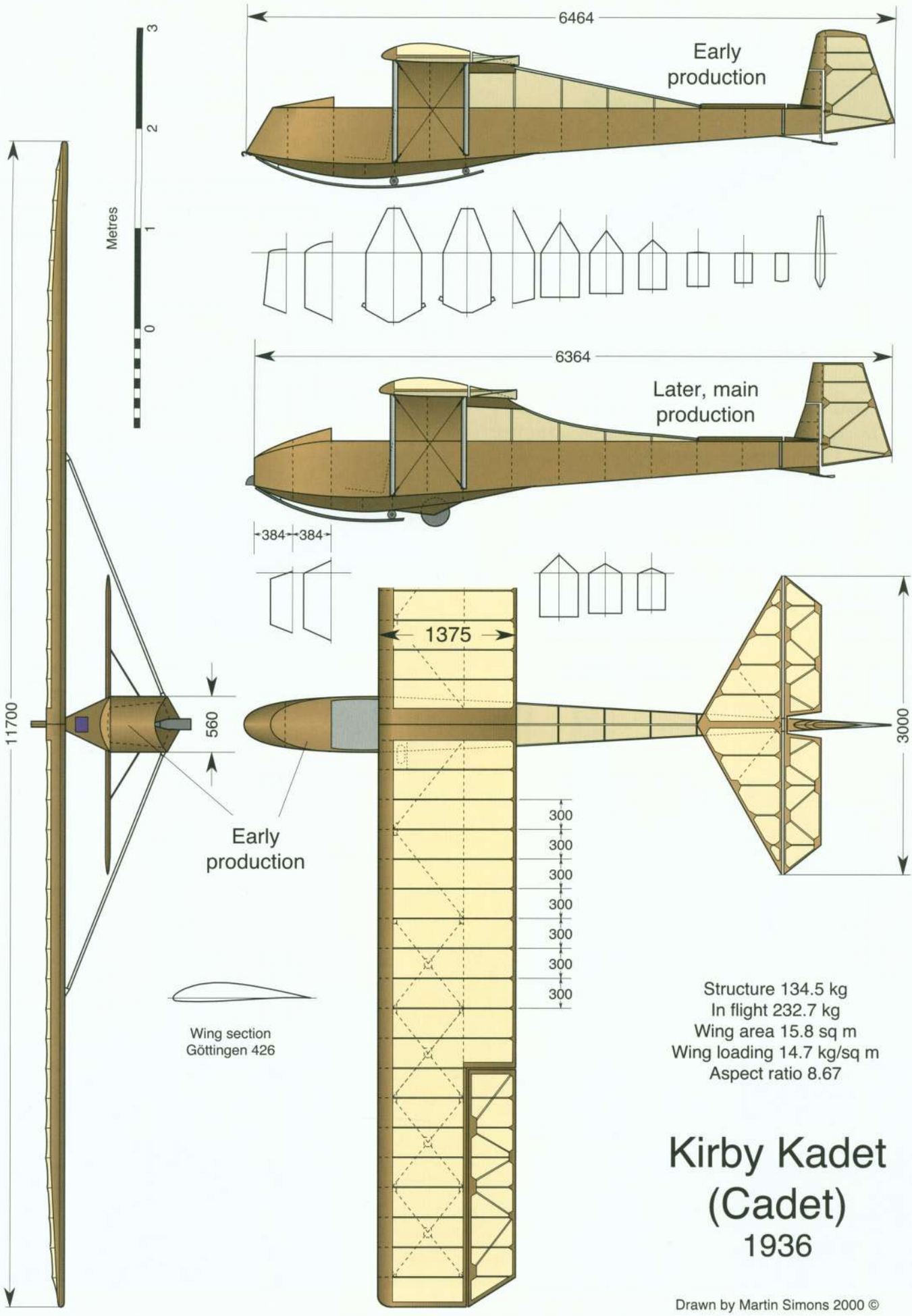
Right: The Kirby Tutor was a Kadet with extended wing to improve the performance.

Below: The Slingsby Kadet was mass produced in England as a trainer one step better than the Dagling primary. It owed more to the German Prüfling and Hols der Teufel than to the Grunau Baby.

Kirby Kadet

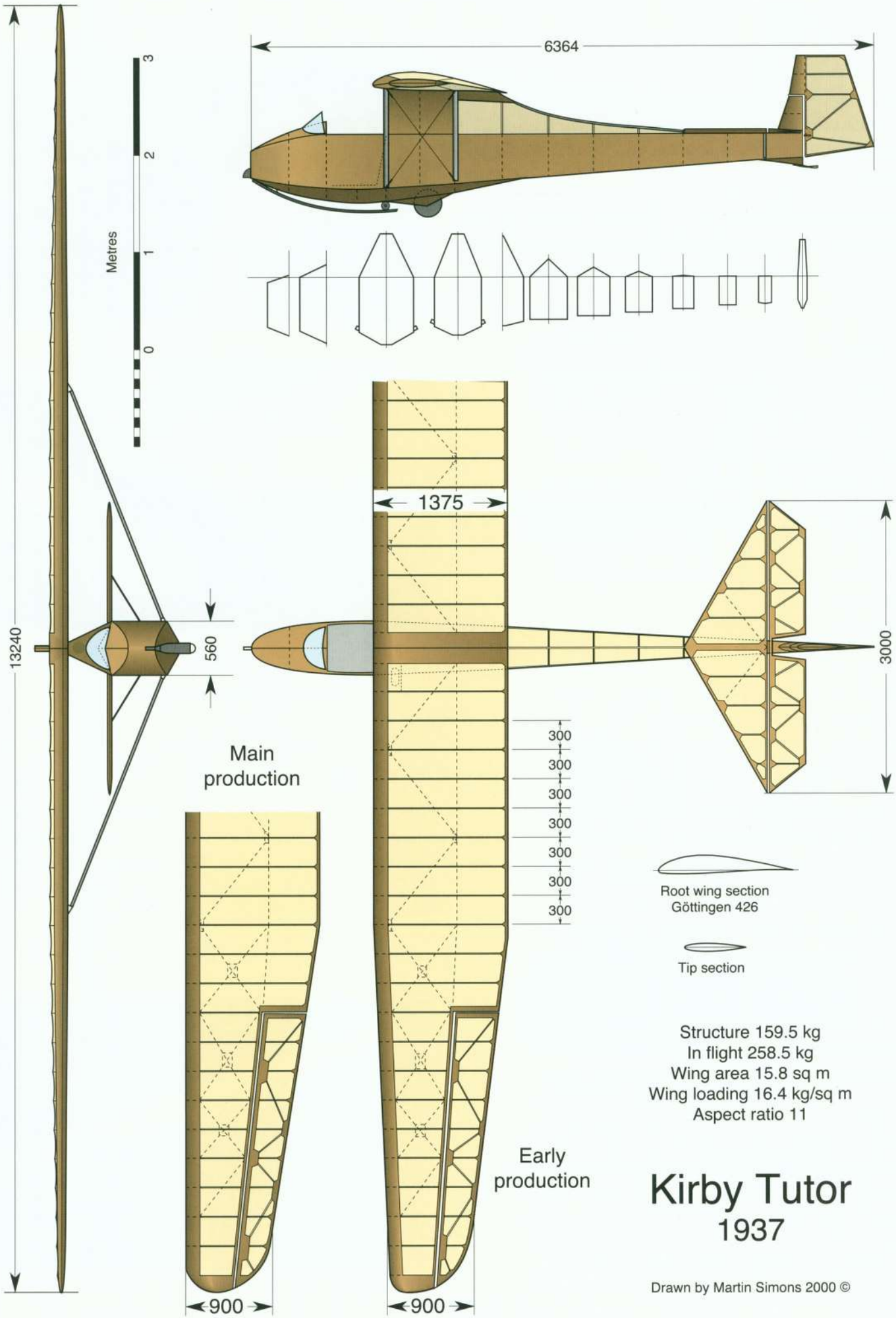
The Kirby Kadet was produced by Slingsby as a trainer just one step better than the primary Dagling, capable of soaring well enough for inexperienced pilots to gain their 'C' badges. John Stanley Sproule was the designer. The Kadet came up to expectations. A few were sold to English clubs and a kit was exported to Australia, before the outbreak of World War 2. During the war it was adopted, with many detailed modifications and strengthening, by the Air Training Corps and, renamed Cadet, used as a primary glider for solo training up to circuit and landing standard. One was built in the USA for Army evaluation. Over 430 were built altogether, the most numerous of all British gliders.

The Australian example still survives complete and is certainly the oldest Kadet in existence. Like the very earliest model, it has no wheel and is of lighter construction than the later ATC Cadets.



Structure 134.5 kg
In flight 232.7 kg
Wing area 15.8 sq m
Wing loading 14.7 kg/sq m
Aspect ratio 8.67

Kirby Kadet (Cadet)
1936



Structure 159.5 kg
In flight 258.5 kg
Wing area 15.8 sq m
Wing loading 16.4 kg/sq m
Aspect ratio 11

Kirby Tutor
1937

Tutor

To improve the soaring performance, new, extended wings were designed for the Cadet, interchangeable with the original wings. The result was called the Kirby Tutor or, in the ATC, Cadet Mark 3. Many Cadets were converted to Tutors. In post war years the type was often used as an early solo aircraft after preliminary training in a two seater. Although the performance was not as good as a Grunau Baby, the Tutor was capable of good soaring flights and one of the few survivors has been used for extended cross country flying in recent years.

King Kite

The King Kite was a very promising design which went badly wrong. Mungo Buxton foresaw the need for pilots to select only the stronger thermals for circling, with high speed flying to penetrate sinking air. The strongly cambered wing profiles of previous times should be replaced by modern sections. In particular the new five digit series from the NACA seemed to offer many advantages. A modern sailplane should have flaps, to enable it to vary the section for slow and fast flight. Gyro instruments for cloud flying were necessary and, to achieve flights to nominated goals, navigational calculations would have to be done.

Buxton announced that he was working on a new design, initially called Hjordis 2, at about the same time as the British Gliding Association decided to send a team to the 1937 International Championships on the Wasserkuppe. The Hjordis 2, re-named King Kite, was the only British sailplane that looked capable of competing on roughly equal terms with the German and Polish types but it did not yet exist. Even on paper the details had not all been worked out.

The design was hastened and Slingsby was commissioned to build three. The prototype was flown in April 1937 by Philip Wills, who was highly impressed at first but was nearly killed when the King Kite refused to recover from a test spin. He tried to bail out but was repeatedly forced back into the cockpit by centrifugal forces. Fortunately his last violent effort to jump brought the King Kite out of the spin and he was able to land safely, though badly shaken.

For the competition he preferred the Hjordis but the three completed King Kites were taken to Germany, with hugely increased rudder areas, and flown there. One span in immediately after a bungee launch, with no injury to the pilot. The other two survived.

It was discovered years later, by Slingsby himself, that a serious and almost unbelievable error when setting up the jigs in the workshops, had resulted in the King Kites having washout built the wrong way round, as 'wash in', thus encouraging wing tip stalling and creating a very dangerous situation for any pilot trying to fly the aircraft.

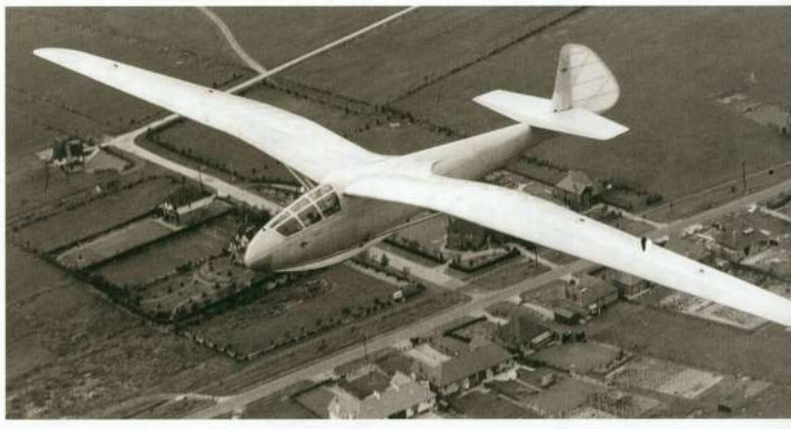
The two King Kites were returned to England and used for some time, one in 1946 finally failing in flight because of glue deterioration, the other being condemned in 1950. A modern replica, with a redesigned wing, was built by David Jones and flown with perfect safety in 1988.

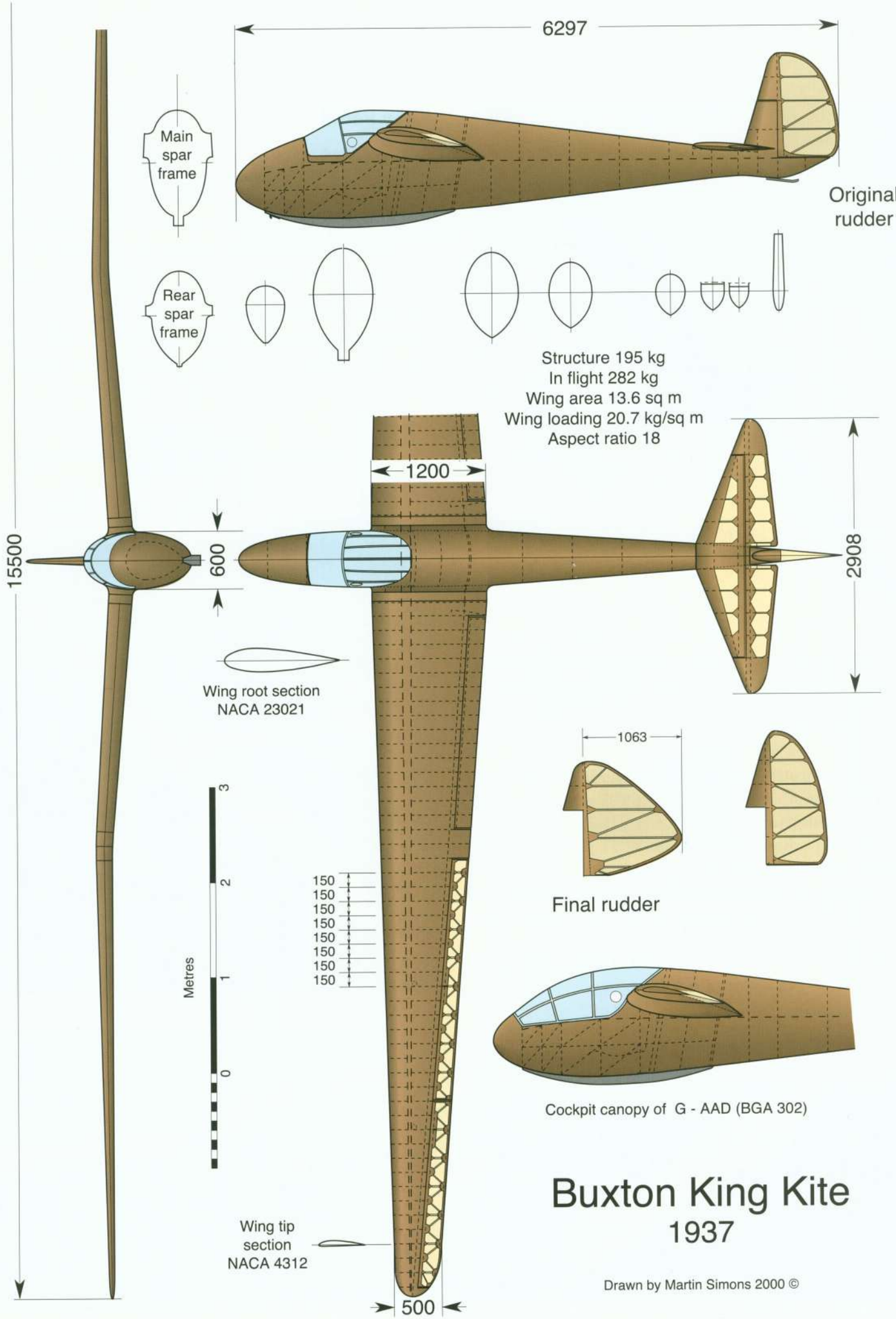
Above: The new King Kite, built with a modern wing profile.
Below: The King Kite, ambitious but spoiled by errors in building.

Kirby Gull

The Gull was Slingsby's development of his earlier, successful Kite. He used more modern wing profiles and extended the span, but retained the strut braced wing. He had visited the Wasserkuppe in 1937 and there saw the Reiher. The cockpit canopy impressed him and he adopted a similar design for the Gull.

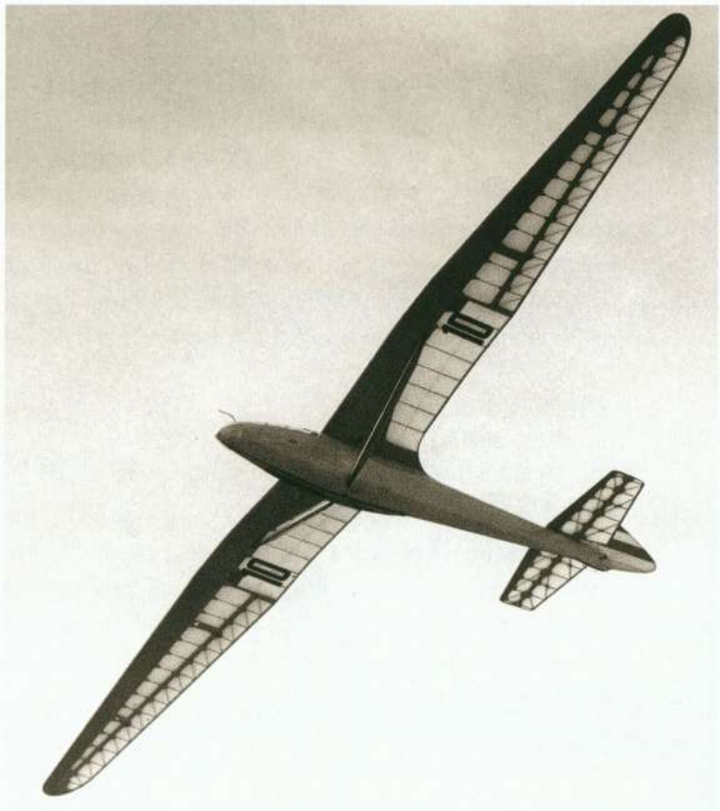
The Kirby Gull by Slingsby, at Dunstable.





Buxton King Kite
1937

Drawn by Martin Simons 2000 ©



Early flights proved the Gull performed as expected, and production began. After a few had been sold, Slingsby increased the tip washout since the Gull was prone to tip stalling. After this the type became popular and nine were built, an additional one, from plans, in the USA.

The Gull is particularly famous because in April 1939, flown by Geoffrey Stephenson, one flew from a winch launch at Dunstable to cross the English Channel, landing near Le Wast in France. It was the first Channel crossing in true soaring flight. (Earlier crossings by Kronfeld were simple glides after high aero tows.)

The prototype was exported to Australia, where it was flown extensively and made many good cross country flights before being retired to museum status.

A cantilever version, the Gull 3, was produced as Slingsby Type 15 in 1940. It still survives, restored, in good condition.

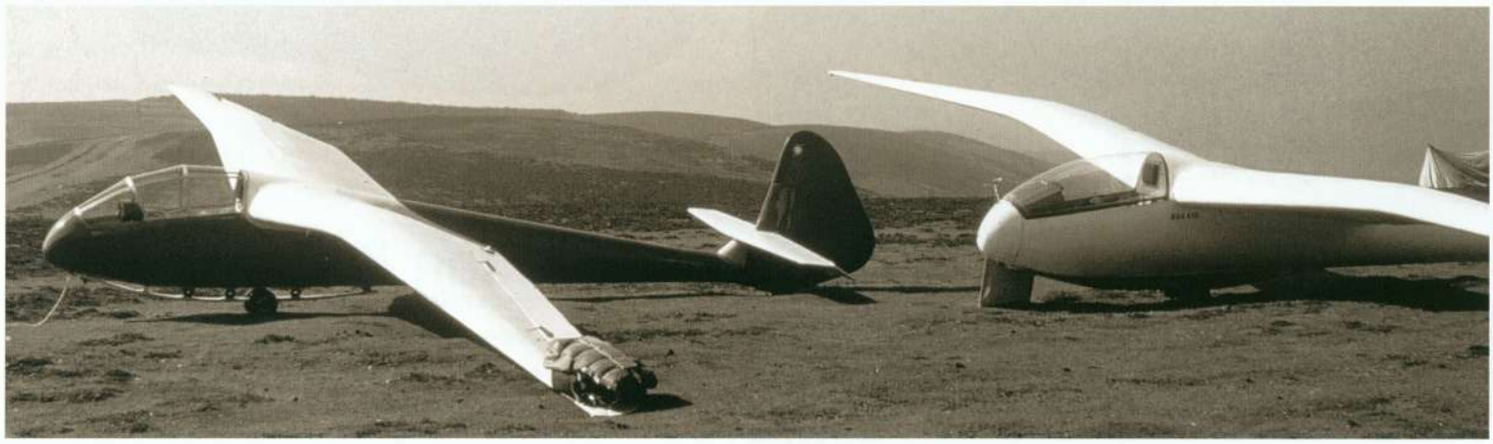
Kirby Petrel

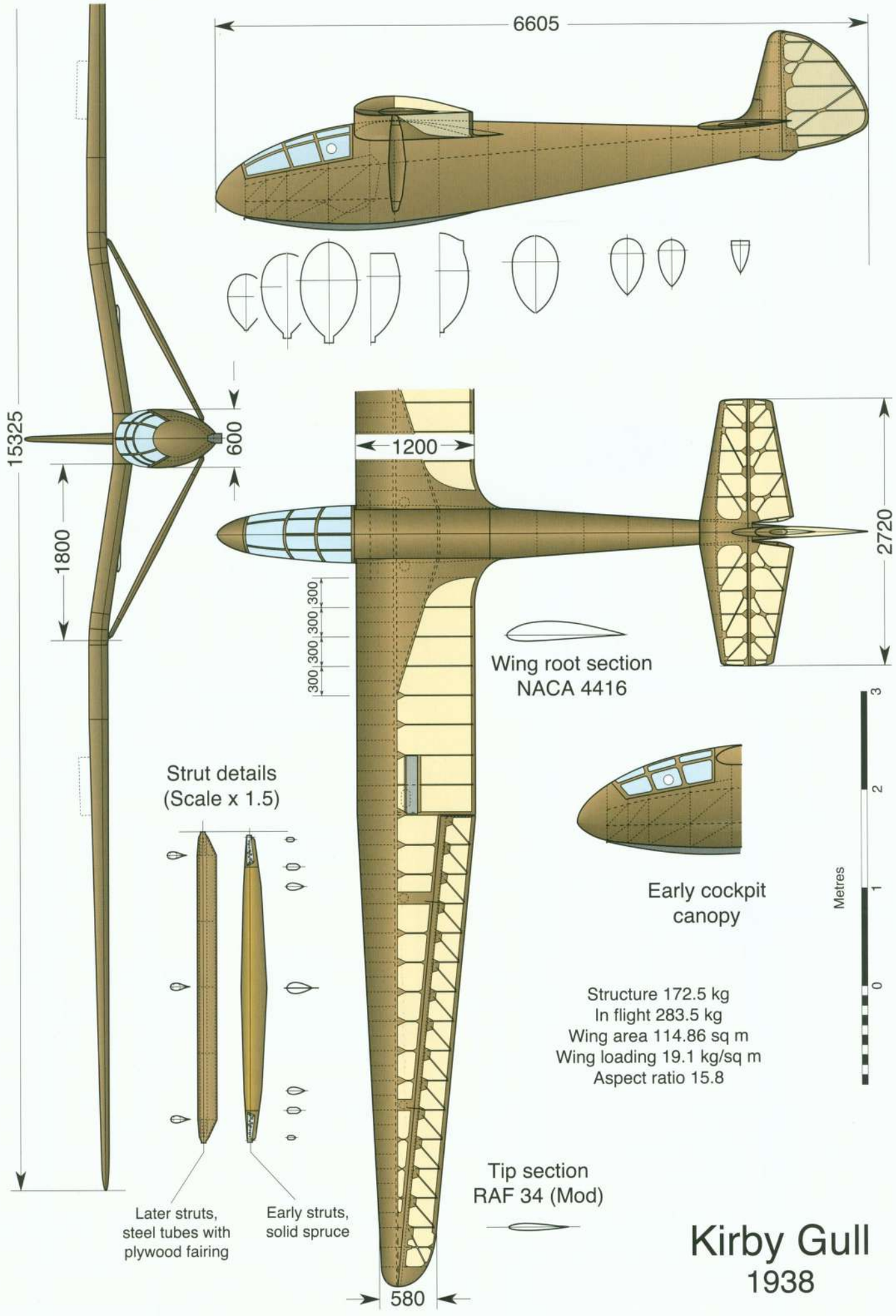
The Kirby Petrel was produced by Slingsby in response to a request, by the English Speedway rider and pilot Frank Charles, for a 'gull winged' version of the German Rhönadler. Slingsby used the Rhönadler drawings with minimal changes to construct the wing, although the fuselage-wing root junction was improved. The canopy preferred by Charles was the wooden hood type with portholes. Two more Petrels were built and sold, with transparent canopies, one with a tailplane and elevator instead of the all moving surface. Charles, in the prototype, was killed at Camphill in a winch launching accident witnessed by the author in 1939. (See the Preface.)

Two Petrels survive and are still in service.

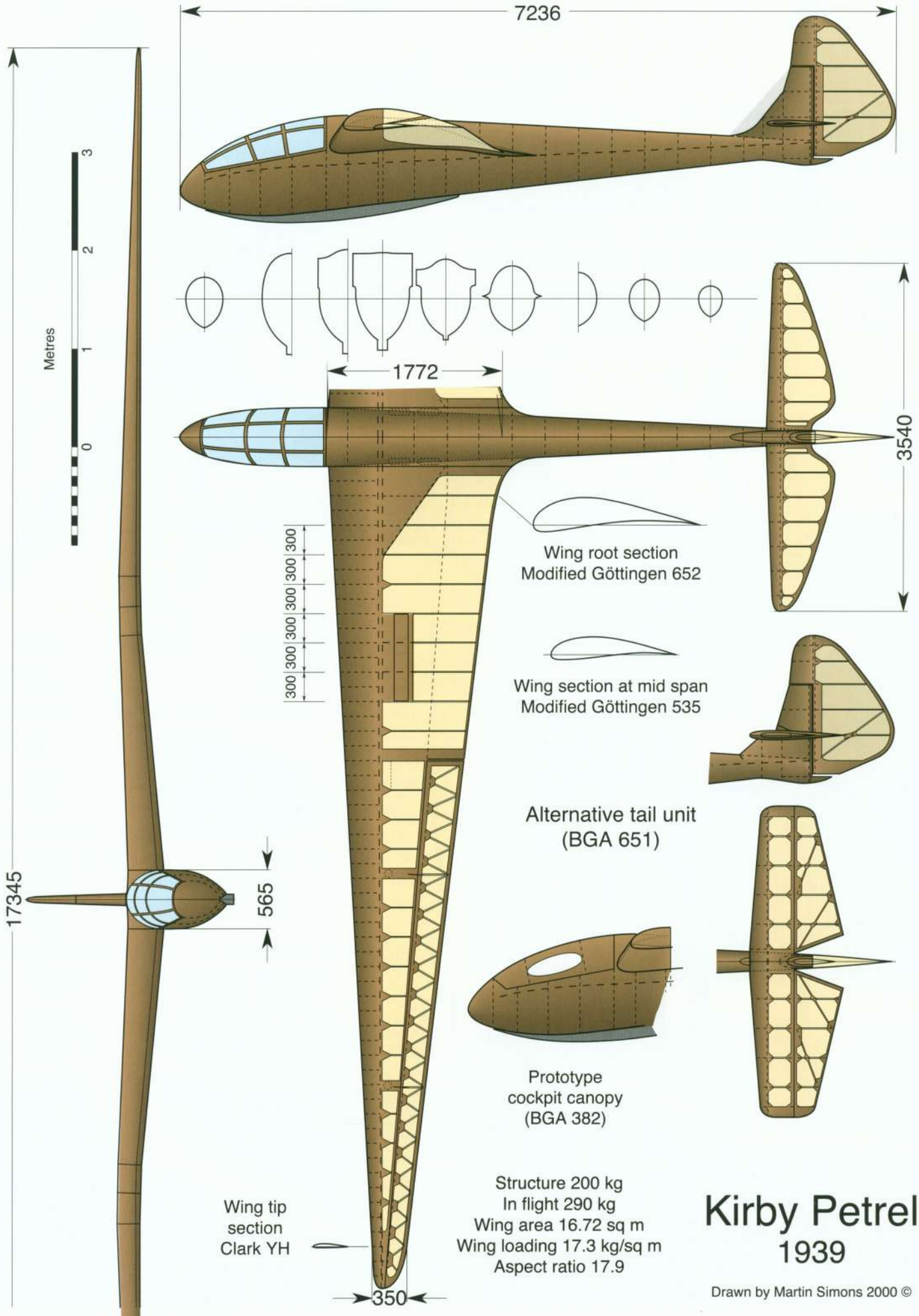
Left above: The Gull competed in the 1939 British Championships.

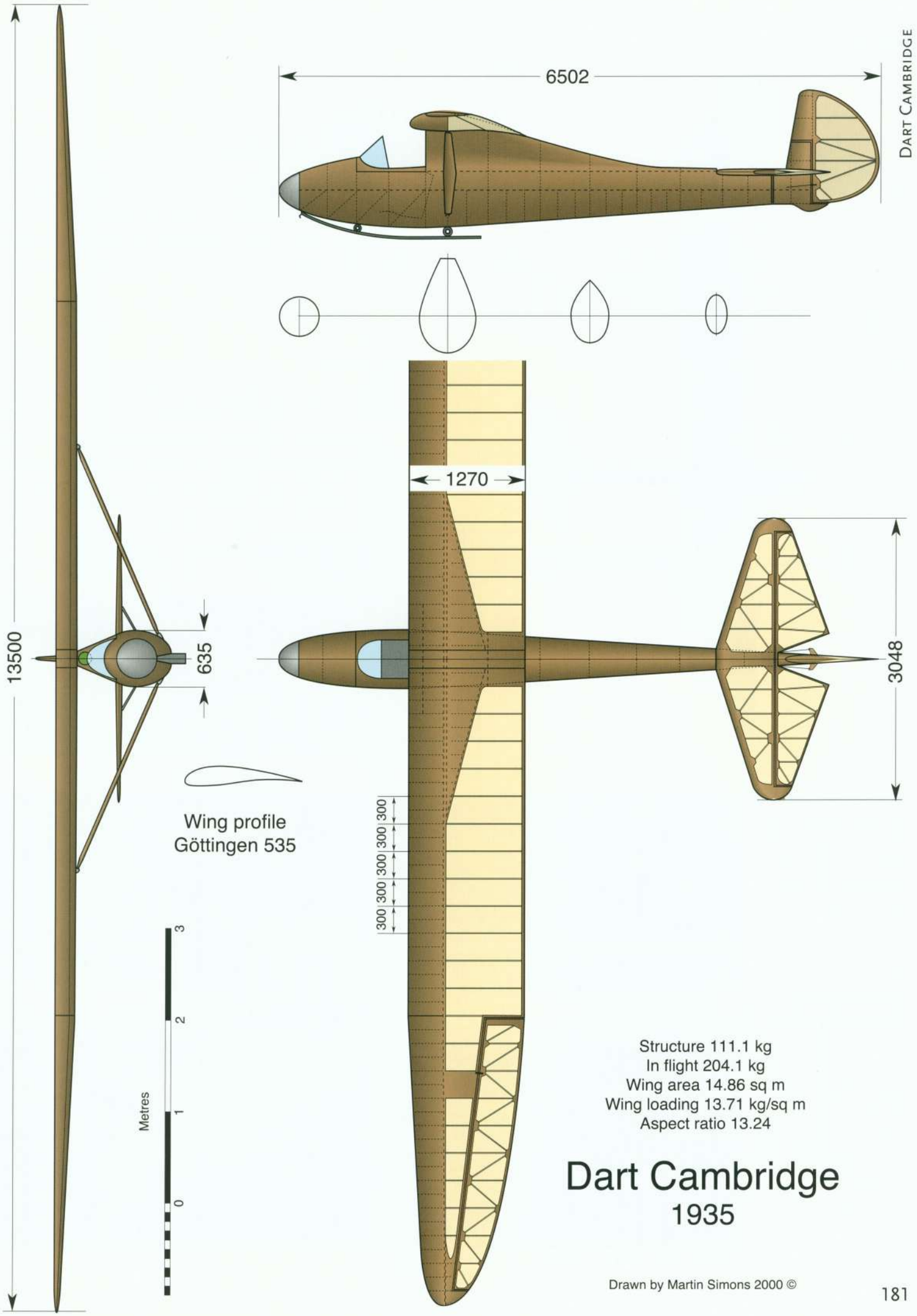
Below both: Known sometimes as the 'gull winged' Rhönadler, the Slingsby Petrel.





Kirby Gull
1938


7236
Metres
0
1
2
3
17345
565
1772
3540
300
300
300
300
300
300
Wing root section
Modified Göttingen 652
Wing section at mid span
Modified Göttingen 535
Alternative tail unit
(BGA 651)
Prototype
cockpit canopy
(BGA 382)
Wing tip
section
Clark YH
350
Structure 200 kg
In flight 290 kg
Wing area 16.72 sq m
Wing loading 17.3 kg/sq m
Aspect ratio 17.9
Kirby Petrel
1939
Drawn by Martin Simons 2000 ©



Structure 111.1 kg
In flight 204.1 kg
Wing area 14.86 sq m
Wing loading 13.71 kg/sq m
Aspect ratio 13.24

Dart Cambridge
1935

Cambridge

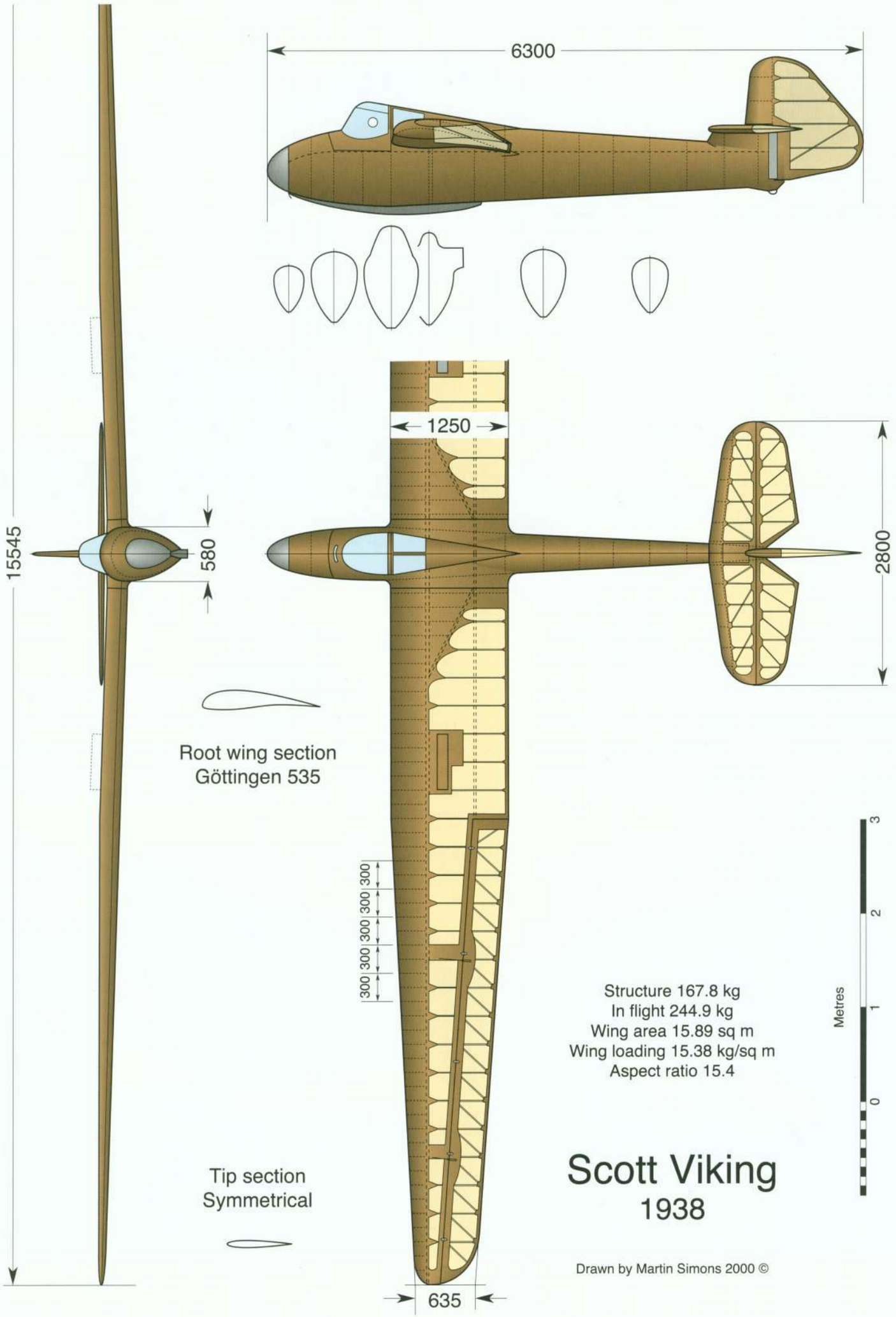
The idea of the Cambridge, built in 1935 by the Dart Aircraft Company of Dunstable was to improve the Grunau Baby by giving it a fully streamlined fuselage. Slingsby's intention with his Kite was the same. Two of the Cambridge were built and were popular with those who flew them, chiefly members of the Cambridge University Gliding Club. One, for some obscure reasons, was nicknamed 'Pons'.

Scott Viking

The Viking, designed by Roy Scott, was aimed at the same, rather limited, market as the Slingsby Gull. Four were completed in 1938. One was exported to Argentina. The others remained in England and were flown quite extensively in the one year remaining before the Second World War. After the war only one survived and was flown a good deal by a succession of private owners. It achieved a height in wave, from Camphill, of 4721 metres after a bungee launch. It remains extant and flyable.

Left above: Like the Kirby Kite, the Cambridge, two of which were built, was closely based on the Grunau Baby but had a streamlined fuselage.

Right above and below: Roy Scott's Viking of 1938



Structure 167.8 kg
In flight 244.9 kg
Wing area 15.89 sq m
Wing loading 15.38 kg/sq m
Aspect ratio 15.4

Scott Viking
1938

CHAPTER 16

Czechoslovakia

Gliding in Czechoslovakia began in the early twenties. More than two dozen different glider types were designed and built before 1925. As elsewhere, interest faded for a time, in particular because a violent wind storm during the national competition meeting in 1925, destroyed or seriously damaged many of the gliders assembled on the ground.

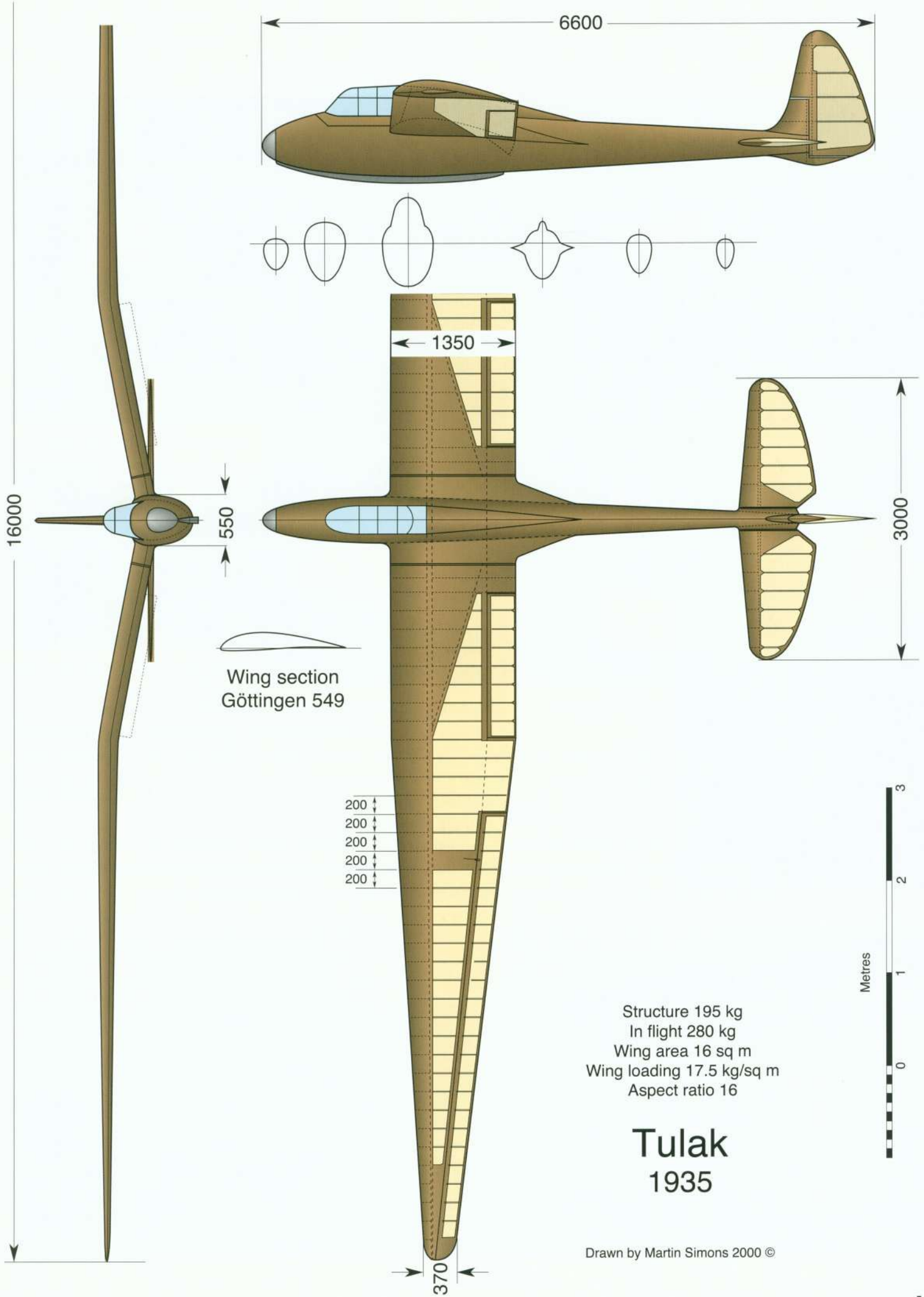
There was revival after 1930, and by 1936 about 60 sailplanes of various types were flying. These included some successful designs, such as the Racek , a 15.2 metre span single seater with a best glide of about 1:22. As tensions in Europe increased and war threatened, activity was seriously reduced. In what was, for this country, the last year of independence before the German occupation, a team of five pilots went to the Wasserkuppe for the International Championships, with four sailplanes. Two of these were of the type Tulak 37, one VSB - 35 and one Ch - 2 Duha., all of Czech design and construction. The poor final scores were probably due to inexperience on the part of the pilots, none of whom, apparently, had achieved the 'Silver C' badge prior to the meeting.

Above: The Tulak had large Fowler type flaps.

Below: The Czechoslovakian 'Tulak'.

Tulak 37

The Tulak was remarkable chiefly because it was equipped with large slotted flaps to assist landing. The wing profile at the root was Gö 549. A wide centre section was built integrally with the fuselage and the wings attached to the reinforced and extended main fuselage frames. Against the German and Polish competitors the Tulak did not show up well. No scoring flights were recorded during the competition.



Structure 195 kg
In flight 280 kg
Wing area 16 sq m
Wing loading 17.5 kg/sq m
Aspect ratio 16

Tulak
1935

Above and right: The Duha 2, OK - Mario, designed and flown at the Internationals by J Chlup, was a much changed version of the Duha 1. It was a fifteen metre sailplane with a wing of pronounced 'gull' form, and a contoured transparent canopy. Chlup did not make a score. It has not been possible to make an accurate drawing of this type.

Left: The Racek.

Below: The VSb 35 flown by Karel Prachar at the Internationals in 1937.

VSB 35

The VSB 35, flown by pilots Prachar and Steyskal, was the only Czech sailplane to score points in the Internationals. Prachar achieved a 91 km cross country flight and a duration of over four hours, during the meeting, which suggests he was at least at Silver C standard, Steyskal, with a 40 km flight, fell short of the required 50 km distance. The sailplane was interesting because it had interchangeable wing tips, allowing the span to be varied between 14 and 18 metres. The horizontal tail was mounted above the fuselage on small pylons in a manner similar to the Polish CW 5. Detailed drawings have not been found.

Chpater 17 France

The Avia 40P, superbly restored, at St Auban s. Garonne.

After the successes of French sailplanes and pilots in the early twenties, a centre for the sport was set up at Combegrasse, but as in Britain, after a flurry of interest there was little activity for several years. A few pioneers such as Georges Abrial continued to build gliders and visited Germany to observe developments. Competitive soaring was revived at Vauville in 1928. Wolf Hirth, in his Württemberg, demonstrated how far things had advanced. French interest revived in 1930 and the firm Avia was founded to build motorless aircraft. The first products were training gliders of various types, including a useful two seat primary glider, the Avia 10a.

Avia 41P

It was significant that in 1931 the French still held contests at the Vauville coastal site. Kronfeld arrived there with the Wien. The Avia design team, led by Raymond Jarlaud, were much impressed and decided to produce a high performance sailplane along similar lines. Eric Nessler, one of the founders of the company and already a well known pilot with experience of building aircraft, designed the fuselage, Jarlaud himself took responsibility for the rest.

Although strongly influenced by the Wien, the French sailplane differed in many ways. It was slightly smaller, though no lighter. The wing, braced with V struts made from streamlined section duralumin tubing, divided in the centre. Jarlaud thought the three-piece structure, as used on the German Professor type, was not the best arrangement. With struts, the maximum bending loads occur where the struts join the wing. A wing joint just outboard of the strut attachments required quite substantial steel fittings to carry the load through the spar. With a two piece strutted wing the root carries no bending at all so the main spar can be very light here to join the fuselage with very simple and light fittings. In the most highly stressed area at the strut ends, the spar is continuous and suitably reinforced.

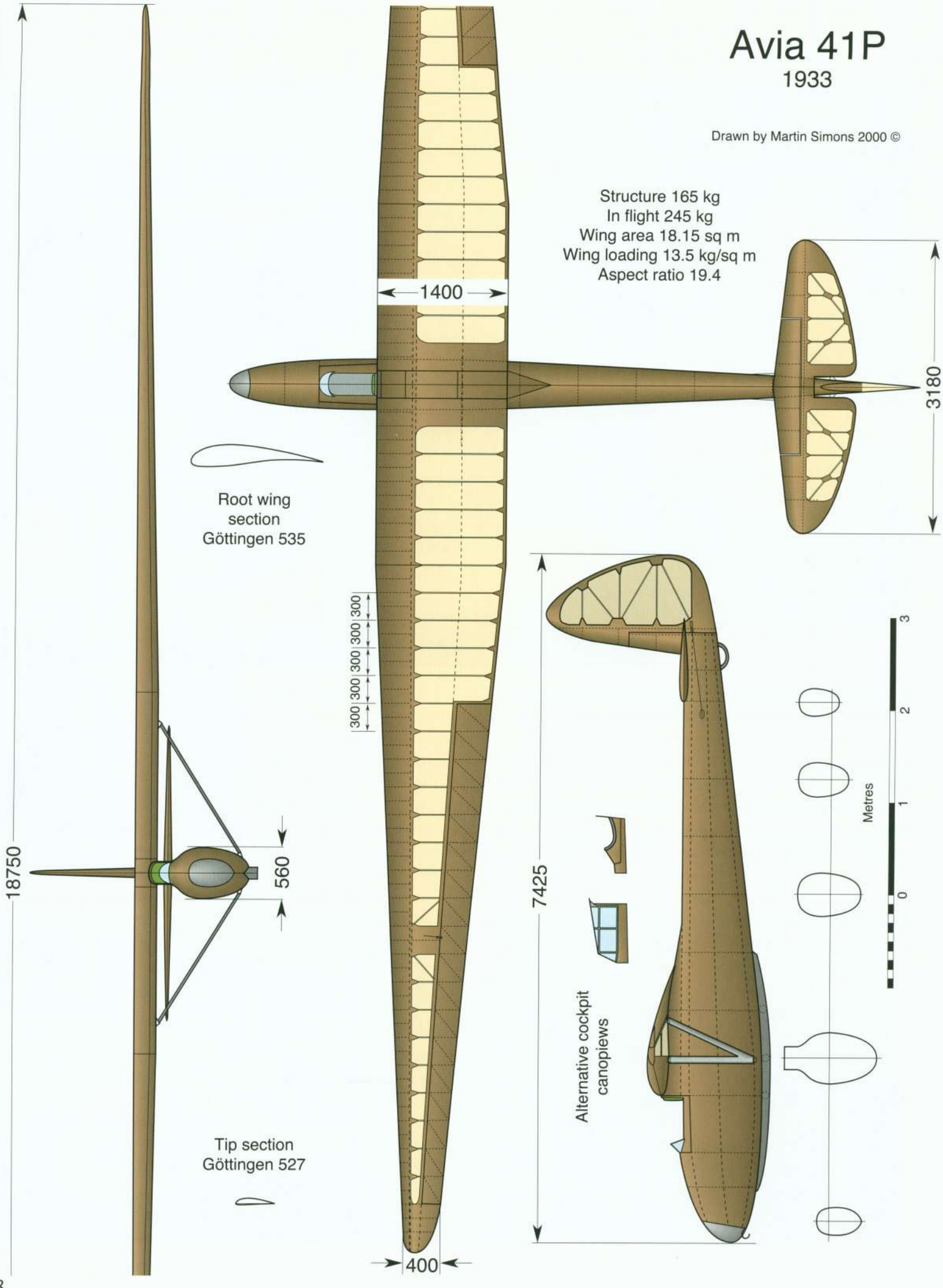
The profiles too were different, Göttingen 535 for the centre section, tapering at the tips to Gö 527, a section of similar thickness but with little undercamber, making the construction of the outer wing much easier. The ailerons, fabric covered but with numerous diagonal bracing ribs, were divided into two sections to reduce distortion under load. They had particularly large and elaborate operating horns, probably to ensure that they did move accurately in response to the pilot's commands. The cockpit was very narrow, restricting sideways hand movements. Instead of a simple stick, Nessler devised a control column like that in some powered aircraft. At the top was a rocking yoke with hand grips for the ailerons, the whole moving fore and aft to control the elevator.

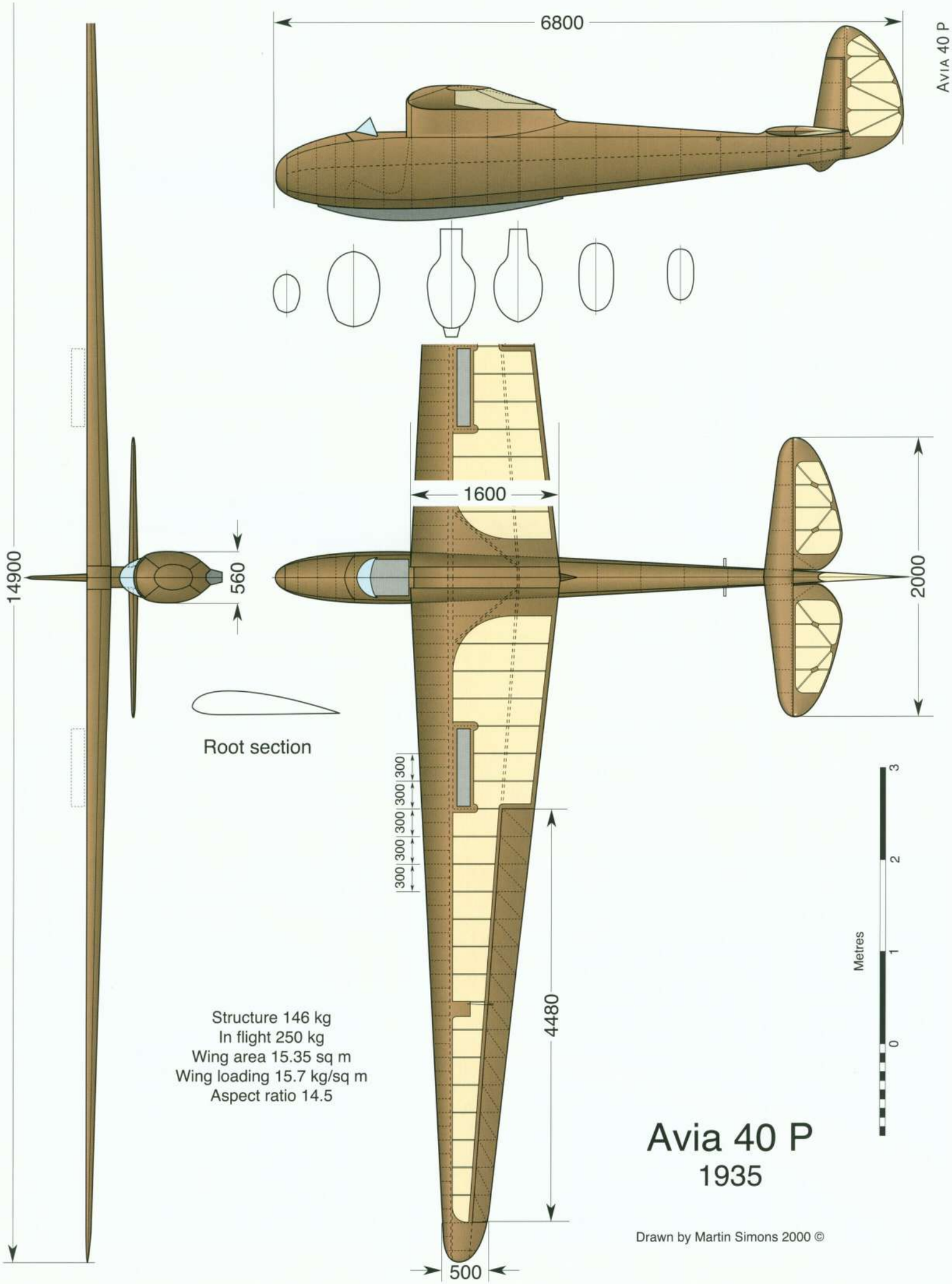
The central pylon wing mounting was lower and the pilot's seat much closer to the wing than on the Wien. The rear fuselage was less slender. There was a small fixed tailplane with hinged elevator and generous aerodynamic balances ahead of the hinge line. The cockpit was open and without a windscreen.

The prototype made its first flight late in 1932 and after further tests in the new year, was taken on tour, making demonstration flights throughout France. It was flown at first only by Georges Bouvier. Eric Nessler took over after a while and made numerous duration and distance flights, becoming the first French pilot to achieve the 'Silver C' badge.

Avia 41P
1933

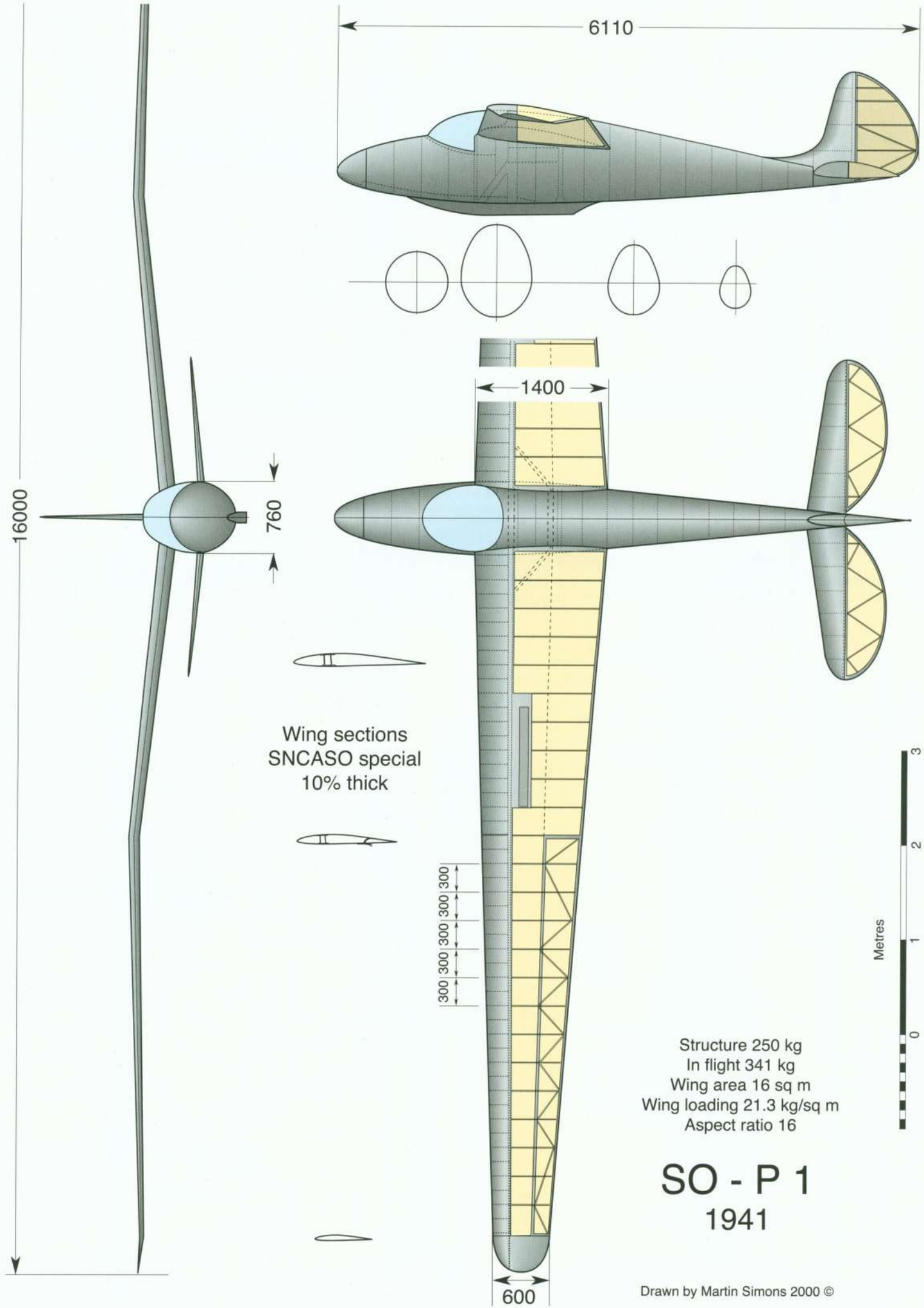
Structure 165 kg
In flight 245 kg
Wing area 18.15 sq m
Wing loading 13.5 kg/sq m
Aspect ratio 19.4





Structure 146 kg
In flight 250 kg
Wing area 15.35 sq m
Wing loading 15.7 kg/sq m
Aspect ratio 14.5

Avia 40 P
1935



Structure 250 kg
In flight 341 kg
Wing area 16 sq m
Wing loading 21.3 kg/sq m
Aspect ratio 16

SO - P 1
1941

Drawn by Martin Simons 2000 ©

A second example of the Avia 41P was completed in 1935. The ailerons were now skinned with plywood and only one central operating horn of ordinary size was necessary. There were other minor changes, especially to the cockpit canopy which after several modifications was at last fully enclosed. Nessler became the chief pilot at the Banne d'Ordanche gliding school. He made this sailplane virtually his own and it became known as L'Aigle de la Banne (The Eagle of la Banne). In it Nessler set most of the French National records, achieving 382.4 km distance in 1938. He represented France at the Salzburg International meeting in 1937 and at Berne in 1938.

Although considered too complex and expensive for large scale production, several more of the Avia 41P were built during the years 1935 to 1939, mostly for the Army gliding section. The precise number is not sure but the most likely figure is five, making a total of seven. Minor modifications were incorporated. Some had a small amount of dihedral, including the third built which was rescued from store in 1950, restored and preserved as a museum exhibit. Nessler's 'Eagle' was taken to Germany by the occupying forces in 1942 and, presumably, destroyed. (A photograph of the Avia 41P appears on page 132 with the Mü 10)

Avia 40P

The Avia 40P, despite its number, first flew several years later than the 41P, in 1935. It was recognised that the larger sailplane was too advanced and costly for the ordinary gliding clubs in France, so the 40P was produced, smaller, less expensive and more within the capacity of inexperienced pilots. It was an orthodox, simple design which proved successful and became the most popular sailplane in France for a decade. The type was used for cross country flying and height gains. National records not taken by the larger Avia 41P usually fell to the 40P, including the feminine distance record of 139.24 km by Marcelle Choisnet in June 1944 and the duration record of 16 hours 44 mins by Suzanne Melk in October 1946. The total built is not certain but exceeded forty. Production continued in France during the Second World War and at least ten were also built and flown in Algeria. Fourteen were taken to Germany during the occupation. One survives in airworthy, restored condition, at St Auban sur Garonne.

SO - P 1

In 1941, despite German occupation of most of France, a group of engineers at the SNCASO aircraft works, without other work, decided to design and build a high performance sailplane using light alloys. The SO - P1 made its first flights in June 1941. Full advantage was taken of the material to produce a strong but light 'gull' wing of only 10% thickness. It had a built up metal box spar with torsion resisting, metal sheet covered leading edge and light ribs behind. The ailerons, carried on a light auxiliary spar, were slotted and mass balanced. Air brakes were fitted. The fuselage was intended to conform to the airflow around the wings, so had a cambered shape in side elevation. The tailplane was mounted low on the rear fuselage but had slight dihedral to avoid touching the ground when the sailplane was at rest with one wing down.

When the whole of France was taken over by the German occupation forces, the sailplane was hidden, to re-emerge after the war when it was re-covered and flown again. When the US National Championships were held in Texas in 1947, it was taken there and among other good flights, set a new French National record distance of 354 km. It was returned to France and stored, apparently never to be flown again.

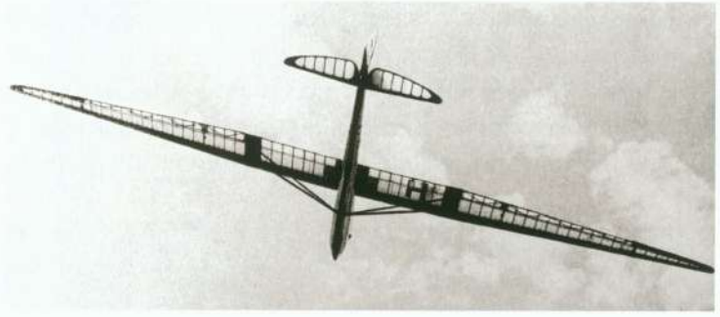
The French SOP 1, one of the first successful all metal sailplanes, visited USA in 1947 to fly in the National Championships.

CHAPTER 18

Hungary

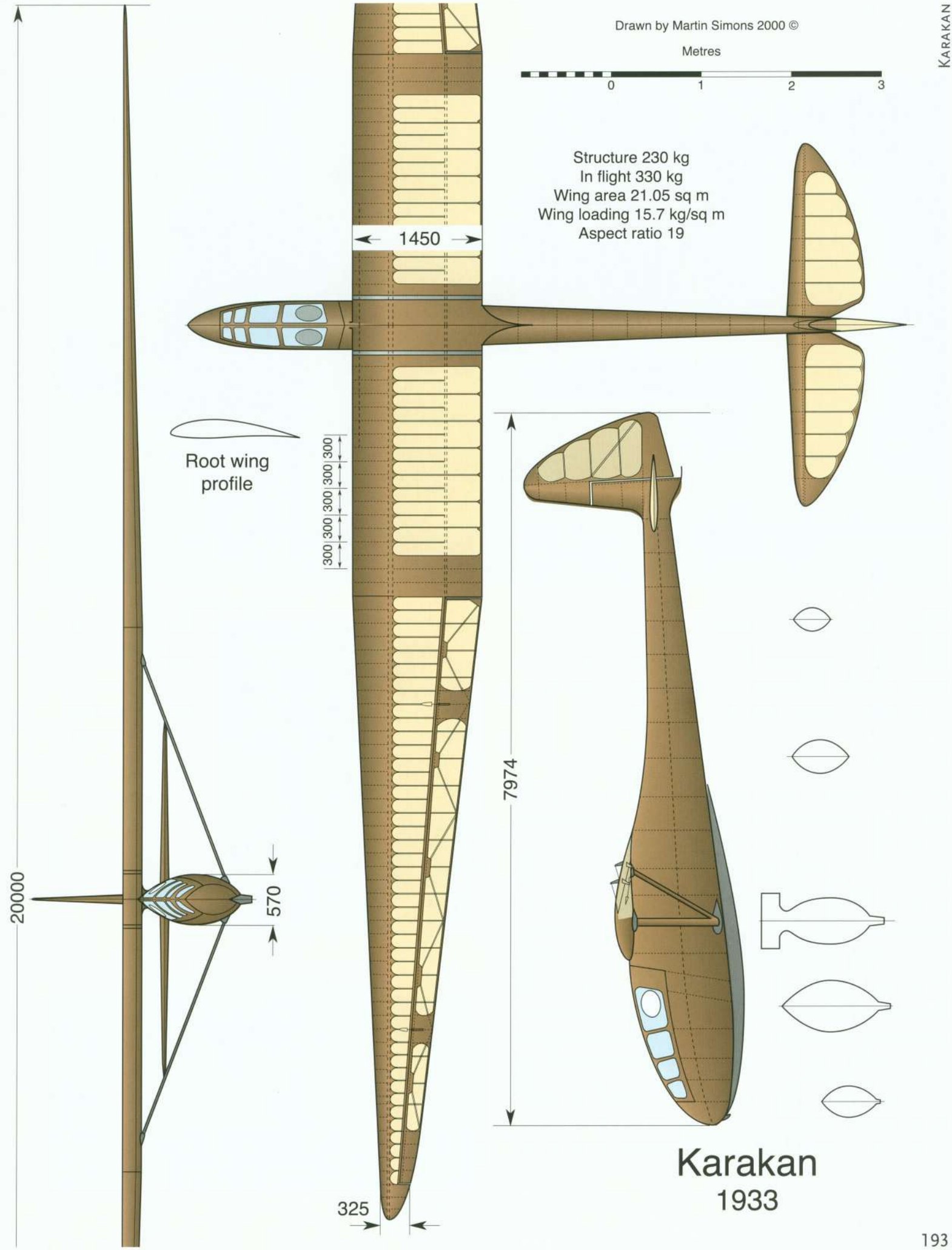
Above: Winter bungee launch of the Karakan.

Right and below: The Hungarian Karakan of 1935.



Karakan

Like Jarlaud and Nessler in France, the Hungarian engineer and pilot Lajos Rotter was much influenced by the Wien when he designed his Karakan, which first flew in 1933. Like Jarlaud, he did not merely copy Kronfeld's sailplane. He too used a two piece wing, but of slightly more span, with original wing profiles, 15.5% thick at the root, and V struts. The fuselage was a slender form with a lens or almond shaped cross section, reducing the width of the pylon as much as possible in the hope of avoiding drag caused by interference between the flow over the wing and that round the fuselage. The wing did not join on the centre line. The upper fuselage frames were extended outwards to form a fixed centre section or stub wing. This simplified the structural and aerodynamic problem of fairing and sealing the wing root. Instead of the traditional open cockpit there was a smoothly contoured canopy built up with transparent panels in a wooden frame. The Karakan was one of the first sailplanes to have this. Large unglazed portholes remained. In other respects the Karakan was of orthodox wooden construction.



Karakan
1933

With his Karakan Rotter, Hungary's first 'Silver C' pilot, set many National records. Two of the type were built and continued in use for years. The second one was lost in a hangar fire in 1942, the prototype, displayed in the National Transport Museum in Budapest, was destroyed in the fighting at the end of World War 2.

Nemere

Lajos Rotter began designing the Nemere late in 1935, to have it ready for the 1936 Berlin ISTUS soaring contest held in parallel with the Olympic Games. Using the experience gained with the Karakan, he made the span 20 metres, but used a cantilever, shoulder wing. The root section was the 19% thick Göttingen 646 changing to the Gö 535 at the inner end of the ailerons and thence to a thin, less cambered tip profile. For take off, a drop-off wheeled dolly was used.

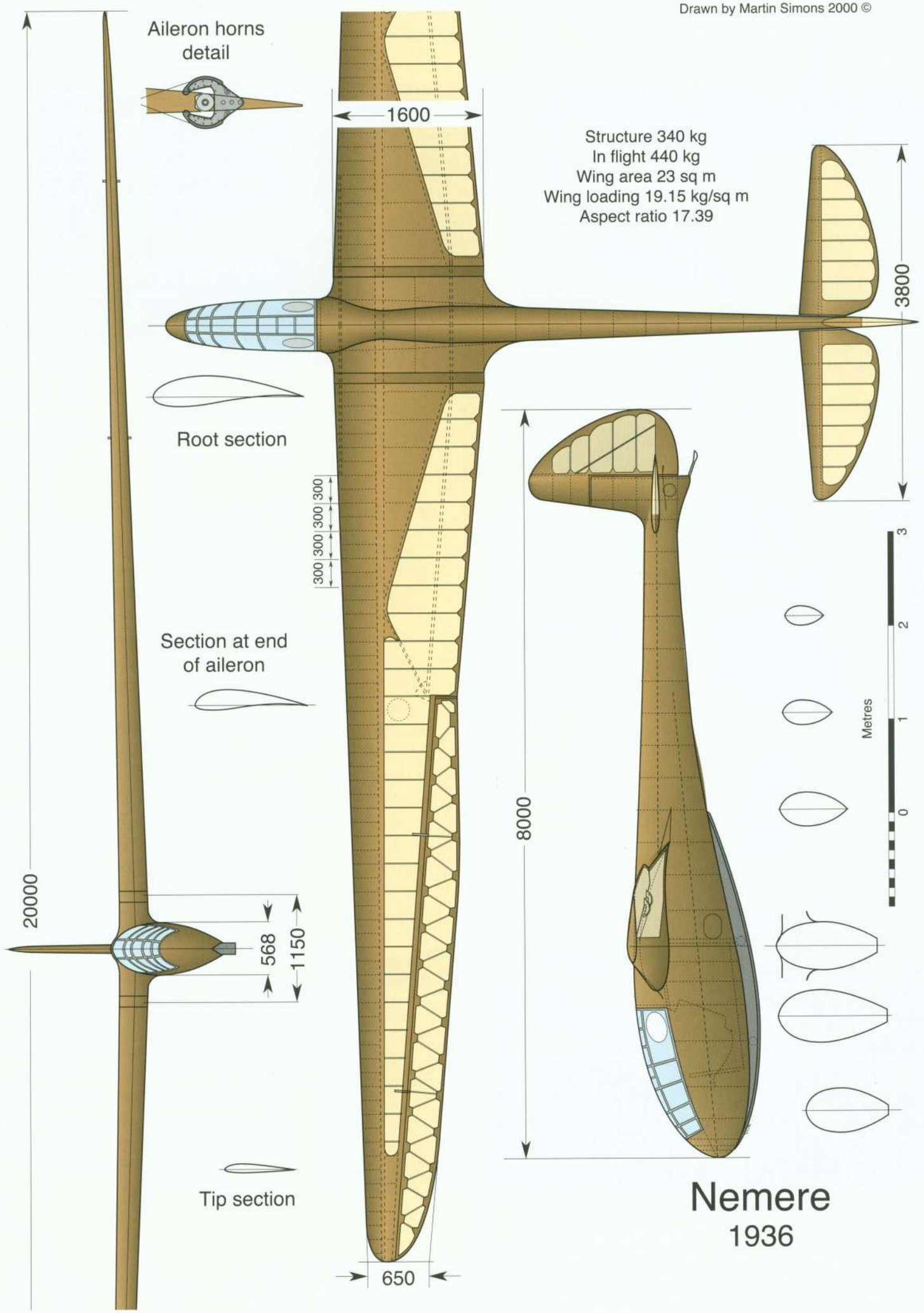
The sailplane was completed in the Royal Hungarian Aircraft Repair Works and test flown only a few days before it was due to appear in Berlin. Once arrived there, Rotter made several flights to familiarise himself with the aircraft, then in favourable conditions set off across country to try to reach Kiel where the Olympic yachting was taking place. To the astonishment of the German pilots, he completed this 336 km goal flight linking the two divisions of the Games. It was the best flight in Europe that year and he was awarded the ISTUS Gold medal.

The Nemere continued in service in Hungary but during the Second World War was stored badly and deteriorated so that it could not fly again.

Above: The Nemere after the flight from Berlin to Kiel.

Left: Rotter in the cockpit. Note the Olympic rings.

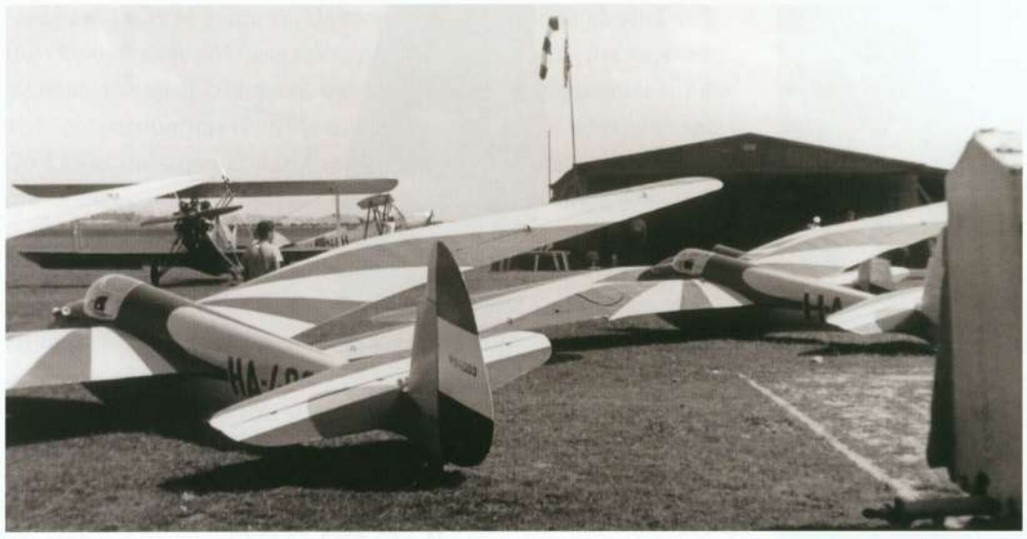
Below: Two of the Nemere were built. HA - 4001 was the second one.



Nemere
1936

Left: The Hungarian M - 22 began construction as a Rhönbussard but was redesigned when the students heard of the Rhönsperber.

Below: The M - 22 was produced in quantity and became very popular.

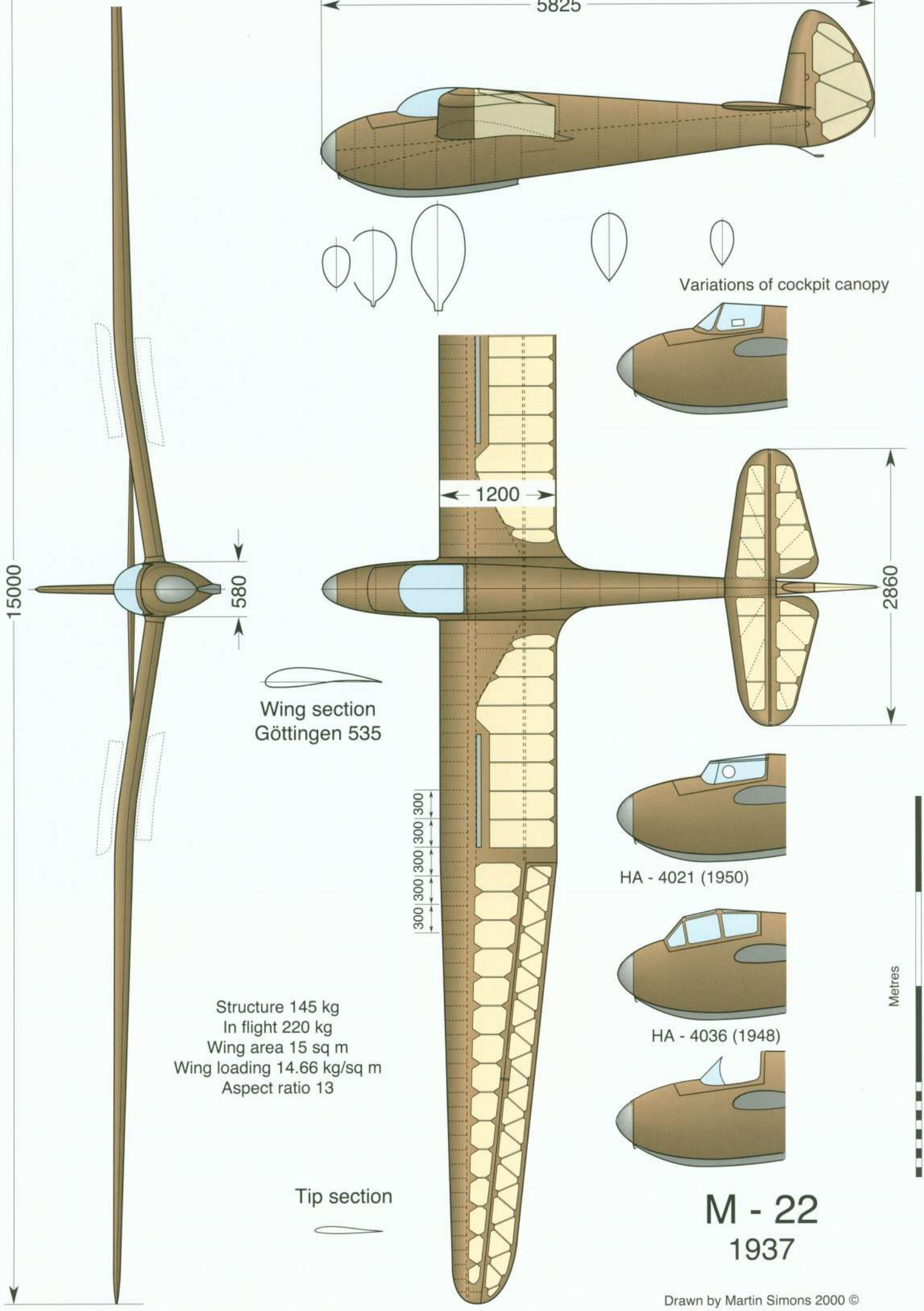


Right above: The M - 22 had a variety of cockpit canopies, some fully moulded in plasic.

M - 22

The M - 22 began as Rhönbussard which was being built from German plans at the Budapest Technical University. When some of the components, such as wing ribs and some of the fuselage frames, had been finished the students heard of Hans Jacobs' new sailplane, the Rhönsperber. András Szokolay and Endre Jancsó, leading the team, decided to develop their own design using the parts they had already made. Most of the Bussard wing was retained but moved down to a mid wing mounting on the short fuselage, and given a 'gull' bend. The main spar joined on the centre line inside the fuselage. The fuselage was essentially the same as the Bussard but with redesigned main frames.

The prototype flew well and from 1937 the M - 22 entered production in the University workshops. An early change to the design was the addition of Schempp Hirth dive brakes. Either an open cockpit or a closed canopy could be used. About fifteen were built and became very popular for cross country flying and aerobatics. An M - 22 broke the Hungarian national distance record with 335 km and the height record with 3770 metres. The prototype M - 22, named Turul was exported to Egypt where, in 1938 the English Group Captain Edward Mole used it for aerobatics, performing slow rolls and outside loops, and, after a tow by an RAF biplane fighter to 4700 metres, he performed 147 consecutive loops on the way down.



Structure 145 kg
In flight 220 kg
Wing area 15 sq m
Wing loading 14.66 kg/sq m
Aspect ratio 13

M - 22
1937

Chapter 19

Italy

There was an international glider meeting at Monte Sisemol near Asiago in 1924 with teams coming from Germany to demonstrate such sailplanes as the Geheimrat, Konsul, and Moritz. Martens broke the world distance record with a 21 km flight. Among the Italians present was Luigi Frederico Teichfuss who had built a successful glider called Condor. As elsewhere, there was something of a hiatus for several years.

A gliding school was started at Pavullo in 1927 with Teichfuss, who himself became a profilic sailplane designer and builder, in charge of the workshops. There were many Italian designs in the following years.

Above: The AL - 3.

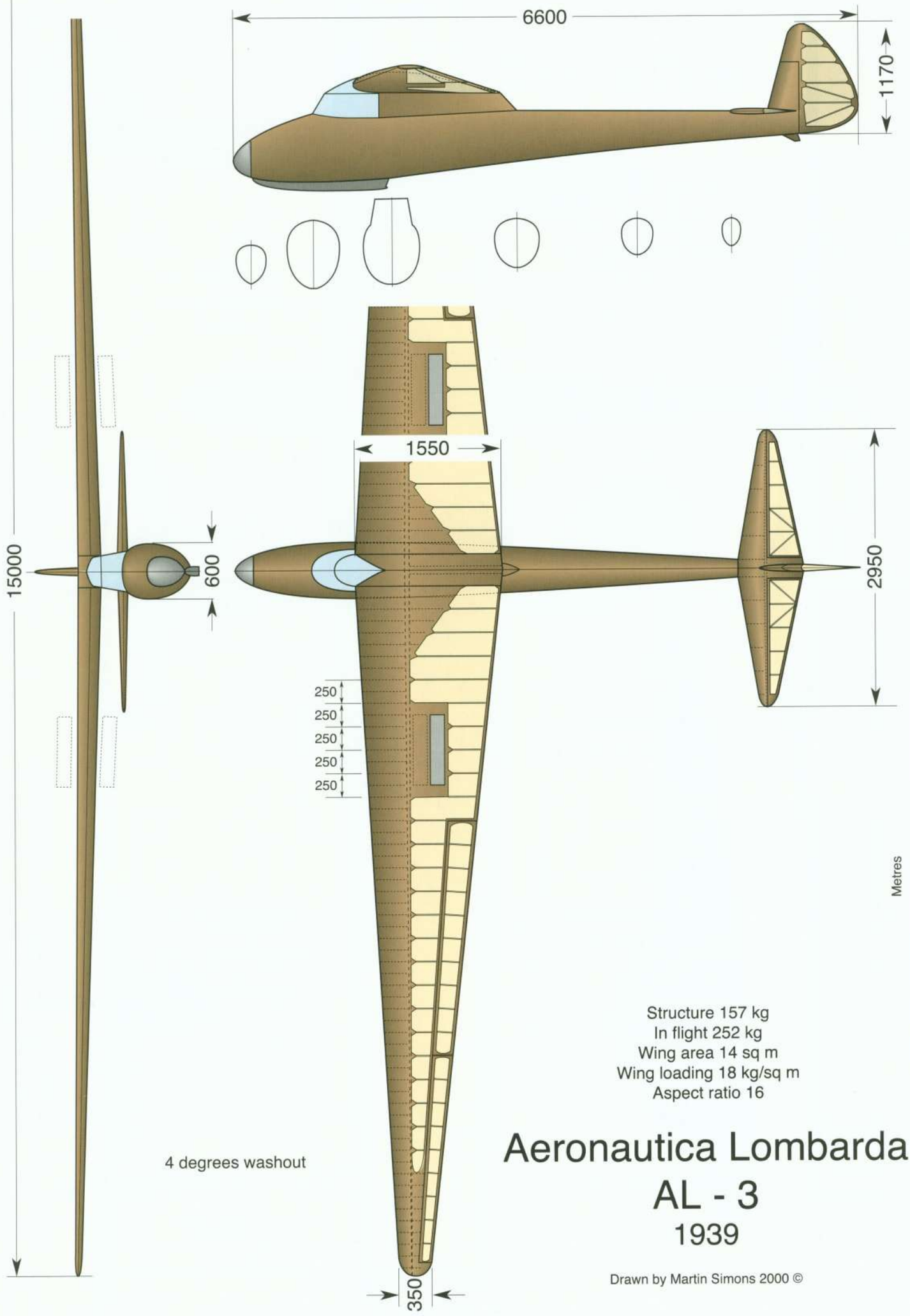
Below: The CVV 4 Pellicano, one of the Italian entrants for the Olympic design contest.

AL 3

The AL - 3 was one of two Italian entries for the Olympic Sailplane design competition in 1939. It was, as the specification required, of straightforward wooden construction. The wing was strongly tapered and used the NACA 4514 profile at the root, tapering to the symmetrical NACA 0012 at the trips, with generous washout to prevent tip stalling. the wing was mounted on a fairly high neck or pylon above the fuselage. In other respects it was similar to the Meise which was preferred by the judges.

CVV - 4 Pellicano

The CVV, Centro Studi ed Ezperienze per il Volo a Vela, (Centre for research in soaring flight) was established at The Milan Polytechnic in 1934 and a series of excellent sailplane designs emerged, including the CVV - 4 Pellicano which was entered for the Olympic Sailplane design competition in 1939. The chief designer of the group was Ermenegildo Preti. The Pellicano conformed to the Olympic specification and was an orthodox fifteen metre wooden sailplane typical of the period. The only complicating factor was the gull wing which may have counted against the design. Rather than the familiar Göttingen aerofoils, the CVV chose to use the NACA four digit series which were less cambered and therefore faster than the sections used for the Meise. The Pellicano was not abandoned after 1939 but entered production and became popular with Italian pilots.

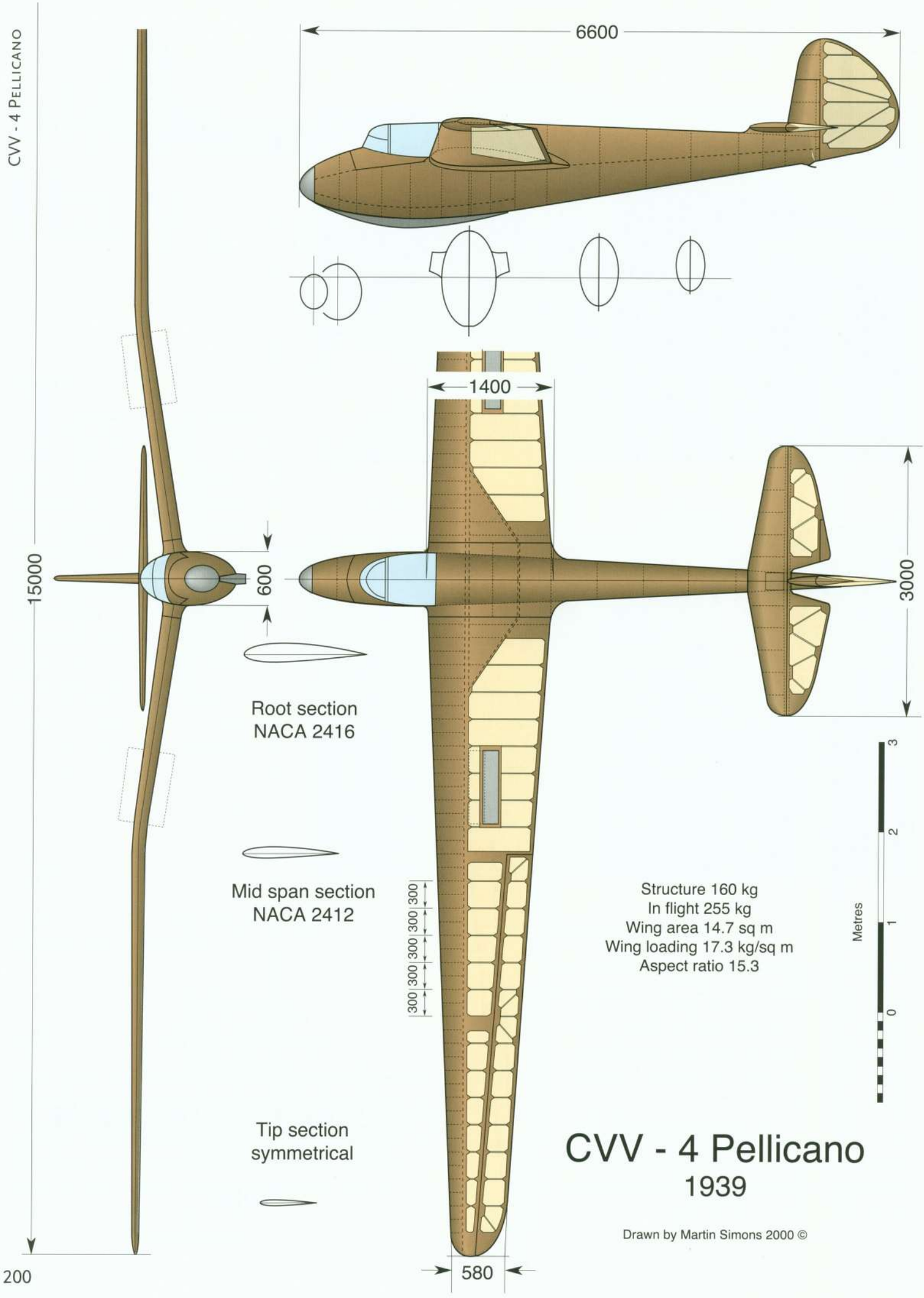


Structure 157 kg
In flight 252 kg
Wing area 14 sq m
Wing loading 18 kg/sq m
Aspect ratio 16

4 degrees washout

Aeronautica Lombarda AL - 3

1939



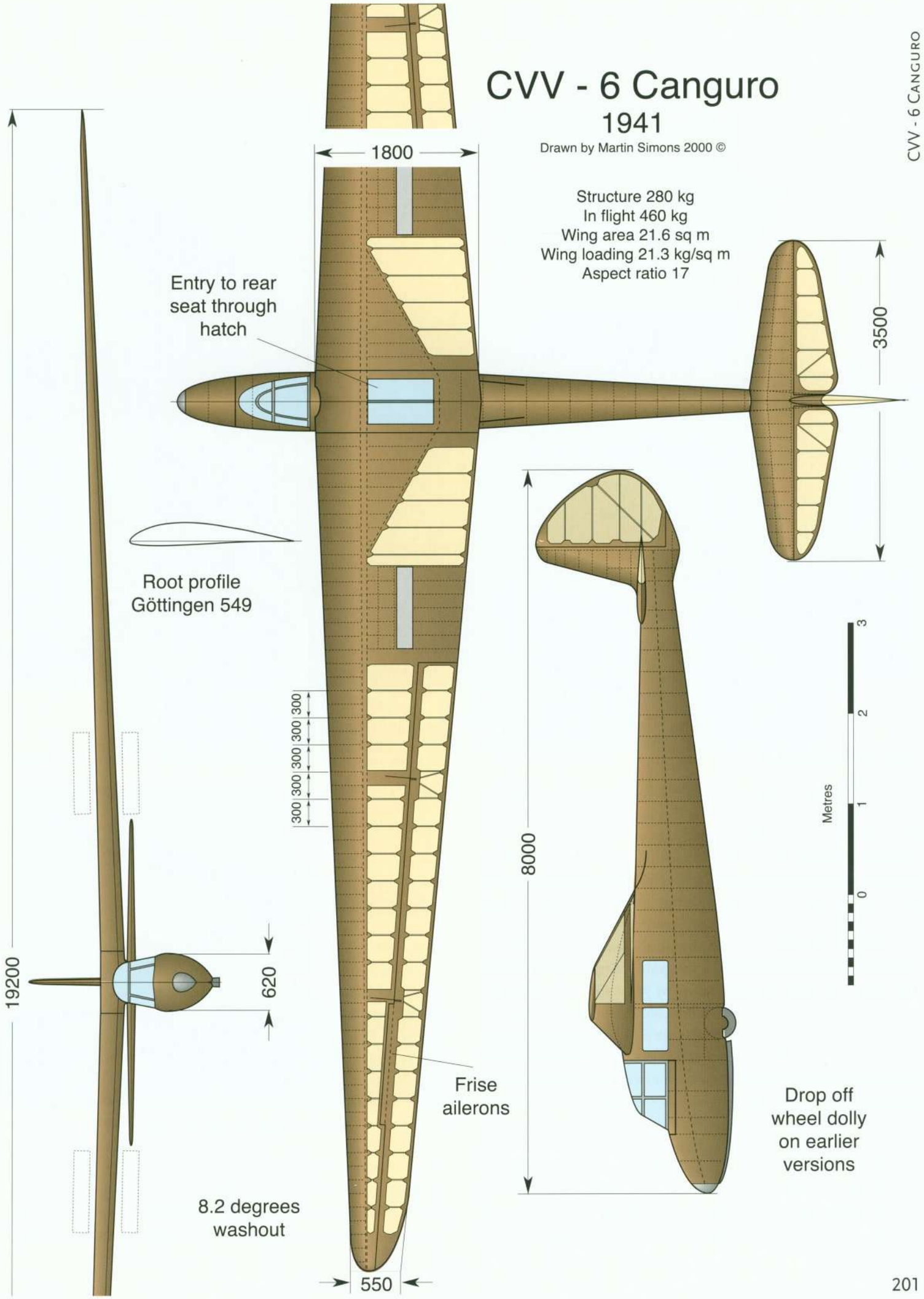
CVV - 4 Pellicano

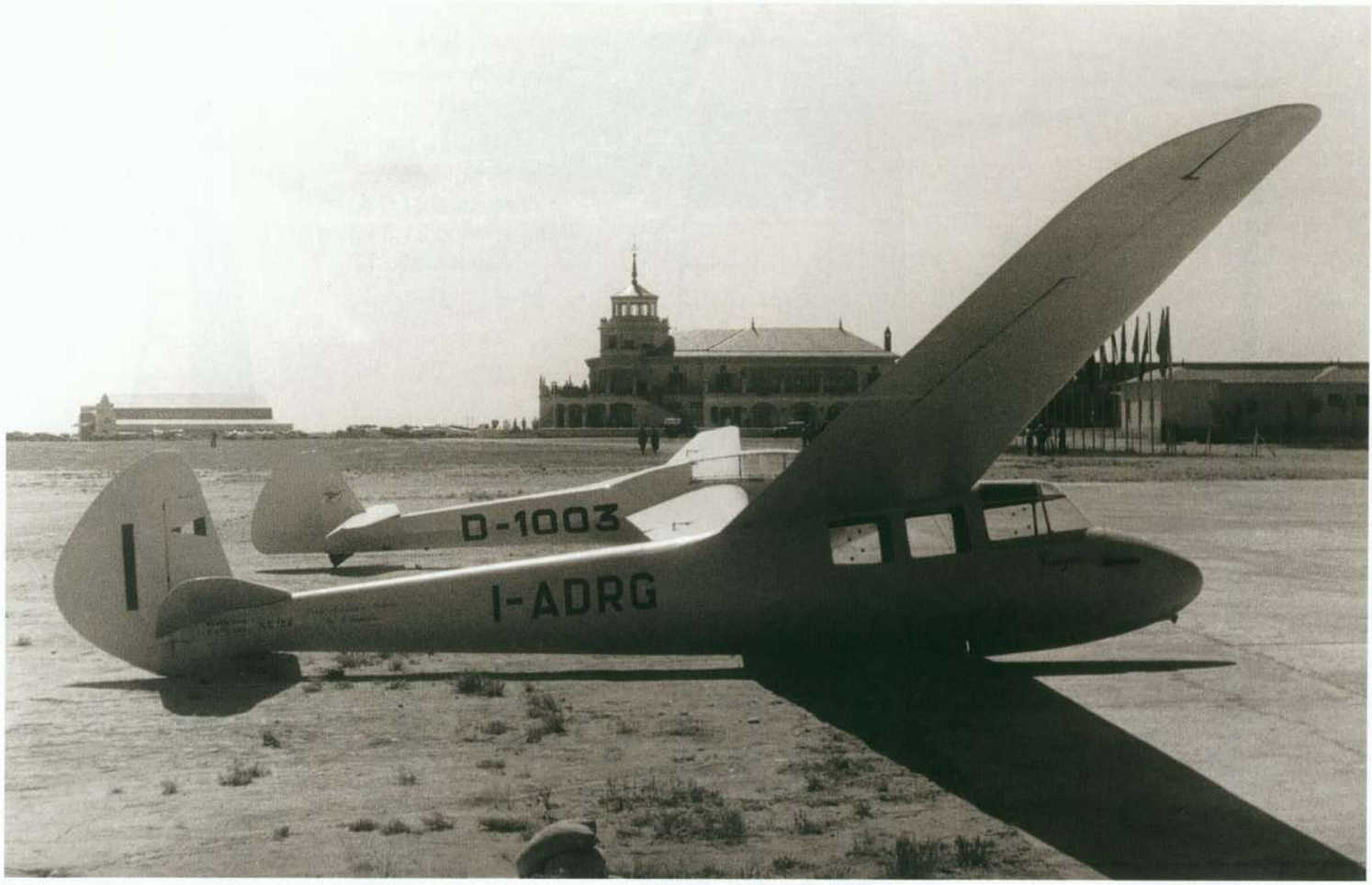
1939

CVV - 6 Canguro

1941

Structure 280 kg
In flight 460 kg
Wing area 21.6 sq m
Wing loading 21.3 kg/sq m
Aspect ratio 17





The CVV 6 Canguro continued in service until the nineteen sixties.

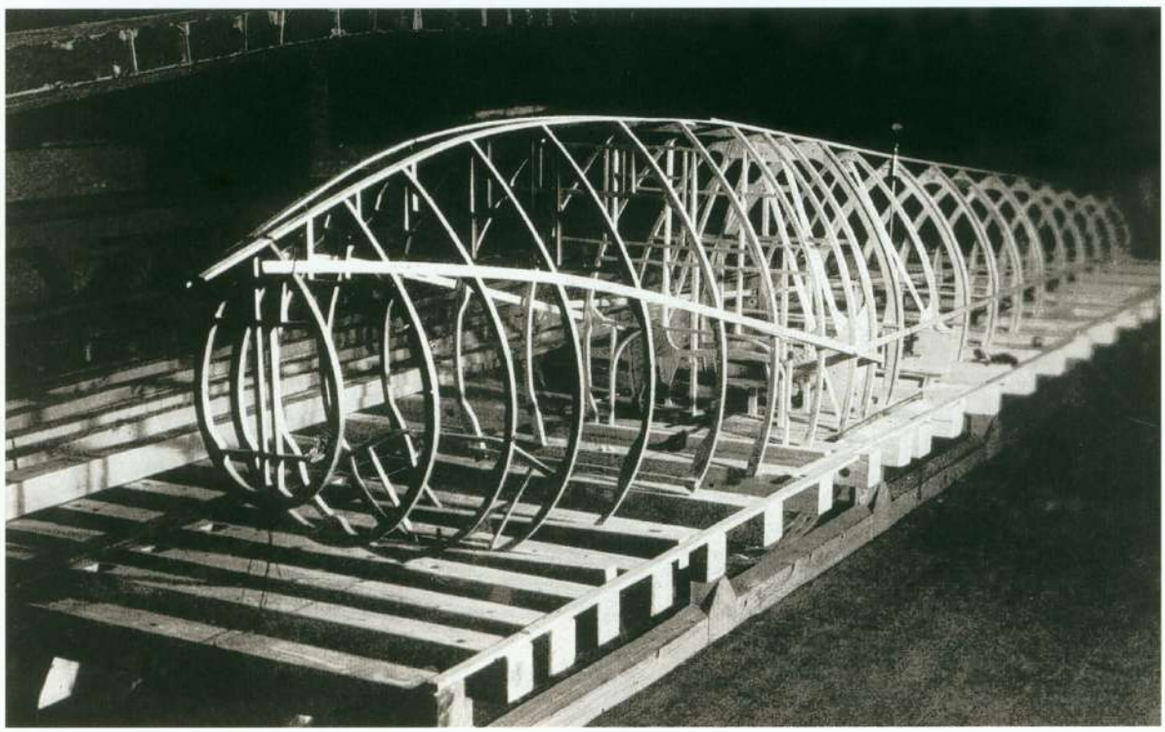
CVV 6 'Canguro'

The CVV 6 Canguro first flew in 1941. It was one of the most elegant two seat sailplanes of its time. The seats were in tandem with the second pilot under the wing with, as usual, restricted outlook, especially upwards. The span of 19.2 metres and the generally clean aerodynamic design ensured that it had an excellent performance. Handling was good. The wing, with the Gö 549 section at the root, was broadly similar to that of the German Weihe. The estimated best glide ratio of 30:1 was probably close to the true figure and the maximum permitted airspeed was 220 kph. Thirty three were built. The type continued in service for many years after the end of the Second World War and one was entered in the World Championships in 1954. A powered version with a 22 HP motor on a pylon above the wing, was developed in 1955. The Canguro Palas, of 1964 had a Turbomeca Palas jet turbine motor in the fuselage in place of the rear cockpit.

The Canguro takes a winch launch at Camphill during the 1954 World Championships.

CHAPTER 20

Japan



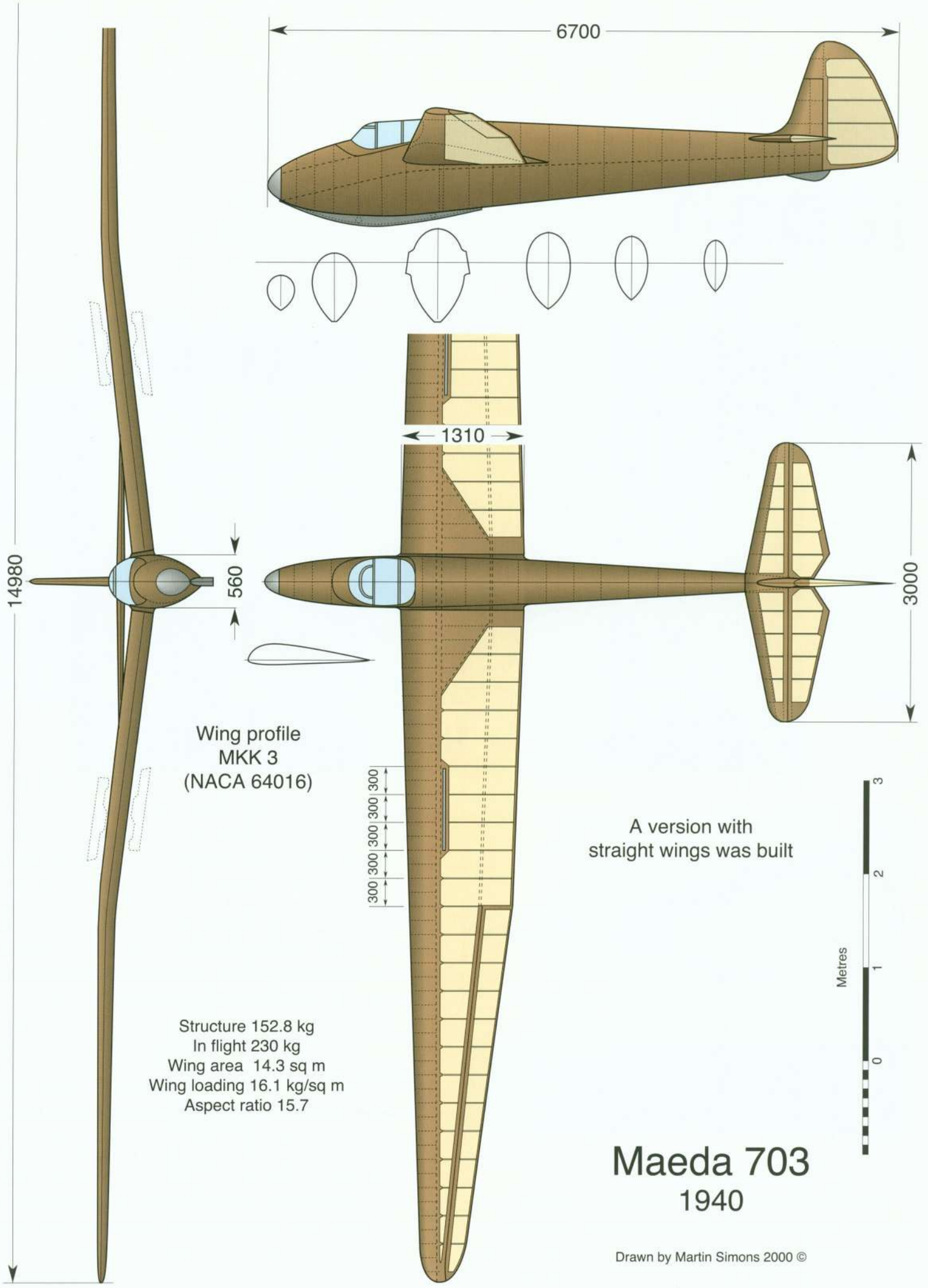
The Maeda 703 fuselage under construktion.

Gliding in Japan began in a very small way in 1930 and until 1935 survived mainly by copying what little was published in Japanese about German aircraft and methods. A very few soaring flights had been made by 1935 when the pioneers decided to try to get an expert German pilot to visit their country, perhaps bringing some modern sailplanes to demonstrate and arouse interest. After failure to gain support from the government or the army, financial backing was obtained from a newspaper, Osaka Mainichi. Wolf Hirth was invited and, to the delight of the Japanese enthusiasts, he arrived in Tokyo on October 2nd 1935 with a Schempp Hirth Wolf, the prototype Minimoa and a Klemm L - 25 tow plane. He also brought plans for the Grunau 9 primary glider and a launching winch.

During the following three months Hirth toured the country demonstrating the new sport and attracted great interest. Japanese glider design and construction were enormously stimulated. Apart from some further imports of the Minimoa and Wolf, Japanese copies of these German sailplanes were built and a great many original designs were worked out, constructed and flown successfully. Almost no news of these developments filtered through to the rest of the world but, as was also true of military aircraft, Japanese sailplanes were very soon capable of matching the rest.

Maeda 703

The Maeda 703 was built in the small factory in Fukuoka by Kenichi Maeda with his engineer friends Kimura and Kurahara in 1940. Their first product had been a primary glider but Maeda made contact with Professor Hiroshi Sato, an engineer with first hand experience of developments in Germany, now teaching at the Kyushu Imperial College. With advice from Sato, careful study of the plans of the German Olympia Meise, and a good deal of argument with his staff, Maeda determined on building three advanced sailplanes to



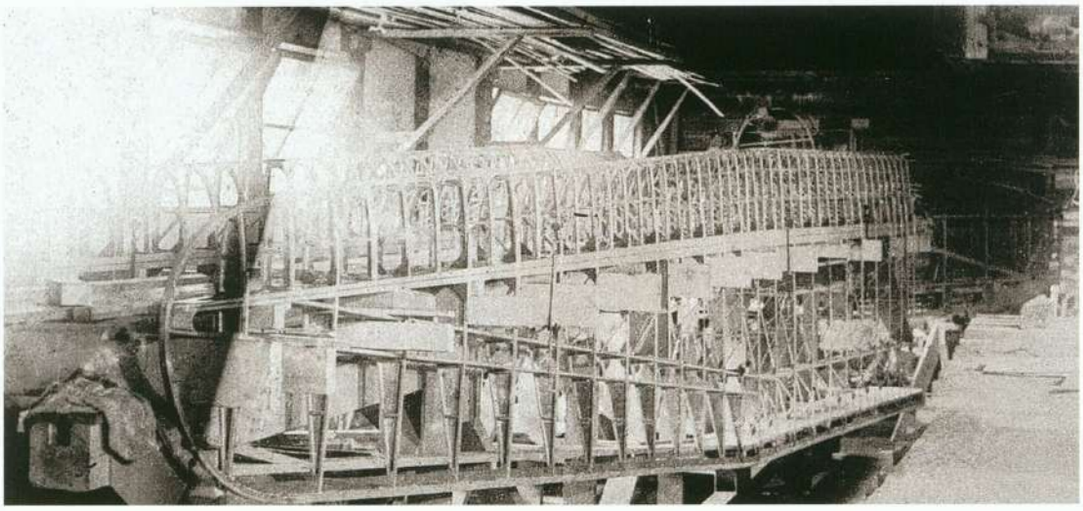
Wing profile
MKK 3
(NACA 64016)

A version with
straight wings was built

Structure 152.8 kg
In flight 230 kg
Wing area 14.3 sq m
Wing loading 16.1 kg/sq m
Aspect ratio 15.7

Metres 0 1 2 3

Maeda 703
1940



Above: The Maeda 703 prototype ready for test flying.

Below: The Madea 703 was built in two forms, with gull wing and straight wing. Here the straight wing version is shown on the jig.

the same plan except that two were to have gull wings because these were fashionable in Europe. The third was to have a straight wing, perhaps simply to find out what, if any, difference it made.

Far from being a mere copy, the Maeda 703, 15 metres span, was an original design with a double tapered wing, mid wing fuselage junction, and a wing profile developed by the Japanese group from the American NACA five digit formula, the NACA 64016. This was 16% thick with the camber concentrated in the first 10% of the chord. As with all this series of profiles, the negative pitching moment was small and the maximum lift coefficient high. Special care was taken to control the wing tip stall with change of profile and washout.

The test flights showed the new sailplane to be very satisfactory with excellent handling and good performance. In February 1941 the pilot Kawabe established a new Japanese duration record of 13 hours, 41 minutes in a Maeda 703, landing in the dark by the light of flares on the airfield.

Further flying and manufacture was prevented by the demands of war, and in 1945 all gliders in Japan were destroyed. Maeda and Sato survived to produce further sailplanes in the post war period.

CHAPTER 21

Poland

Above: The Salamandra, designed in 1936 by Waclaw Czerwinski in Poland, filled the same role as the Grunau Baby but was an entirely original design.

Below: The Salamandra was produced in large numbers both before and after the Second World War.

Gliding in Poland, as in most countries outside Germany, began in a small way during the early nineteen twenties but became more popular after thermal soaring was discovered in 1928. There was considerable support from the State after 1930. Subsidised gliding centres were established and official specifications for a range of training and high performance sailplanes were issued.

Salamandra

Training methods in Poland followed the German style but the importation of German aircraft was discouraged. Design and production contracts were agreed with Polish aircraft companies. A specification drafted by the Ministry of Transport was met by the Salamandra of the WWS, Wojskowe Warszaty Szybowcowe (Military Aviation Workshops). The designer was Waclaw Czerwínski, already one of the leading Polish designers.

The Salamandra first flew in 1936 but was really much older in conception. In general layout and appearance it resembled the strut and wire braced CW - 2, a nacelled primary glider produced by Czerwinski in 1929. This had made the first soaring flights and duration records in Poland and had been developed and improved since. The Salamandra had a superior wing to give it a better soaring performance. It proved successful in its training role and became very popular. About 140 were built before 1939, with exports to the Baltic Republics, Finland and Yugoslavia.

After 1945 the Polish gliding movement, with the rest of the country, was devastated. Apart from sheer physical destruction and enormous casualties, the eastern and western frontiers were shifted some 200 kilometres westwards, displacing about half the population.

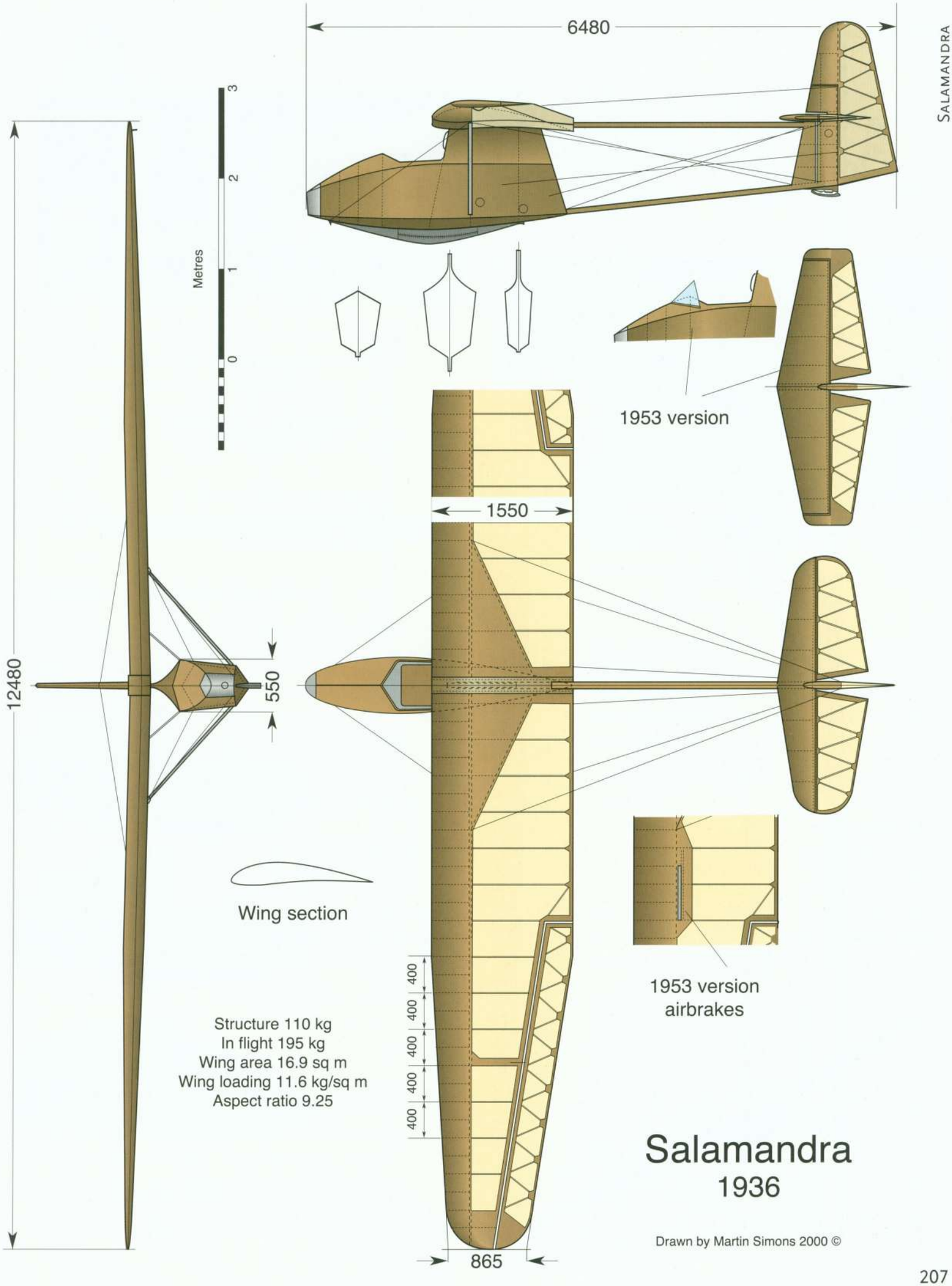
The gliding movement recovered and was given high priority by the State. The only surviving Salamandra was used as the basis for new drawings. Production began again, 223 being built. Fifty of these were exported to China and more were built there under licence. Meanwhile Czerwinski, the designer, forced to leave Poland during the war, had settled in Canada. There he produced the Sparrow and the Robin, almost unaltered from the original Salamandra.

Although never approaching the production figures of the Grunau Baby, total production numbers for the Salamandra exceeded 500.

Komar

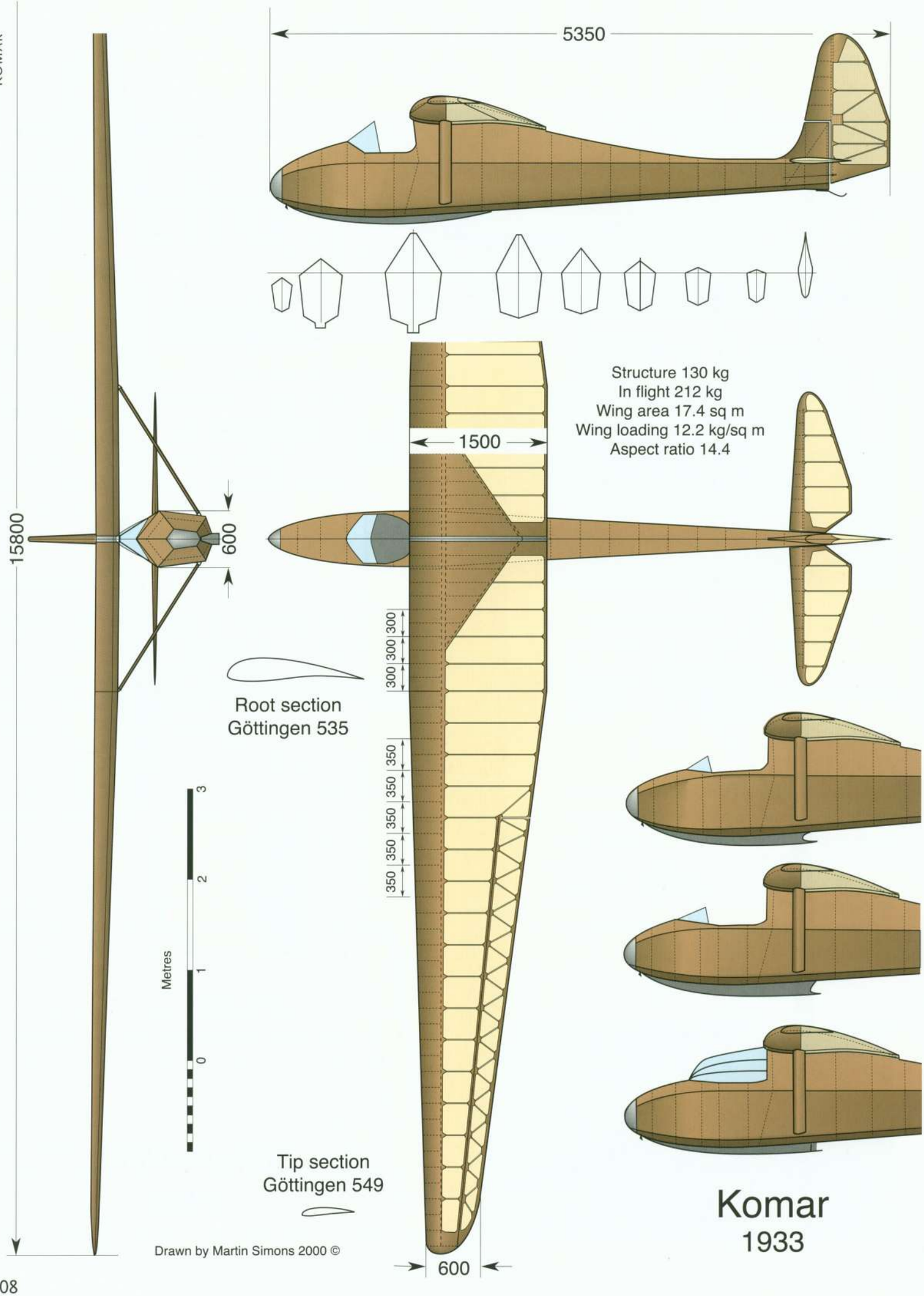
The Komar, first flown in 1933, was the Polish equivalent of the Professor or ESG 31. It was designed by Antoni Kojcan, using the Gö 535 wing profile tapering to Gö 549 at the tips. The fuselage was of the hexagonal box form with an open cockpit. The performance was good enough for cross country flying in thermals but structural deficiencies were discovered at high airspeeds. The structure was strengthened to produce the Komar bis. After this the Komar be-

Below: Komar flying over Vrsac town in 1939. The inscription under the wing reads 'Merry Christmas' in the Serbian Language.



Structure 110 kg
In flight 195 kg
Wing area 16.9 sq m
Wing loading 11.6 kg/sq m
Aspect ratio 9.25

Salamandra
1936


5350
15800
600
1500
Structure 130 kg
In flight 212 kg
Wing area 17.4 sq m
Wing loading 12.2 kg/sq m
Aspect ratio 14.4
300
300
300
350
350
350
350
350
Root section
Göttingen 535
Metres
0
1
2
3
Tip section
Göttingen 549
600
Drawn by Martin Simons 2000 ©

Komar
1933

came the standard Polish sailplane for early cross country flying up to and beyond Silver C standard. The type was used to break records too. A Komar made the first flight across the Gulf of Finland in 1934, after a high aero tow from Estonia to glide 60 km to Helsinki. There were exports to Estonia, and in Yugoslavia the type was built under licence. Yugoslavian pilots in the 1937 International championships, flew Komars.

After World War 2, production of the Komar restarted in Poland, using a surviving set of drawings found in Yugoslavia.

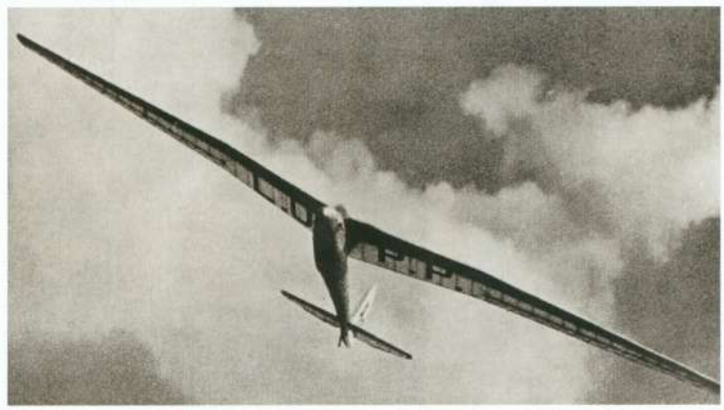
The SG 21 Lwow and the SG - 3

The association of aviation students at the Technical University of Lwow, ZASPL, were equivalent to a German University Akaflieg. In 1931, led by Stefan Grzeszczyk they designed a high performance sailplane, the SG - 21 Lwow. Influence from across the border was relatively slight. It soon broke all the important national soaring records and also undertook some long aero towed flights. The design was officially approved and an improved version, the SG - 28, was built. Both these sailplanes were taken to Germany to fly at the 1932 Rhön competitions and did well, though their performances were overshadowed by the German aces.

Following the success of these sailplanes Grzeszczyk developed the SG - 3 and SG - 3 bis/36. These became the most popular sailplanes in Poland and about 25 were built, with many successes in contests, cross country and record flights. They continued in use until 1938 when new airworthiness requirements required them all to be strengthened. The labour required was considerable and most were scrapped rather than modified.

Czerwinski CW 5

Waclaw Czerwinski, responding to an official requirement for a high performance sailplane designed the CW 5, which first flew in 1933. Although he was aware of the latest German developments, Czerwinski's design was original. He decided against using the extraordinary Gö 652 profile which Lippisch adopted for the Fafnir. The profile used was much thinner and less cambered, tested in a wind tunnel at the Warsaw Aerodynamic Institute. The wing had a 'gull' form



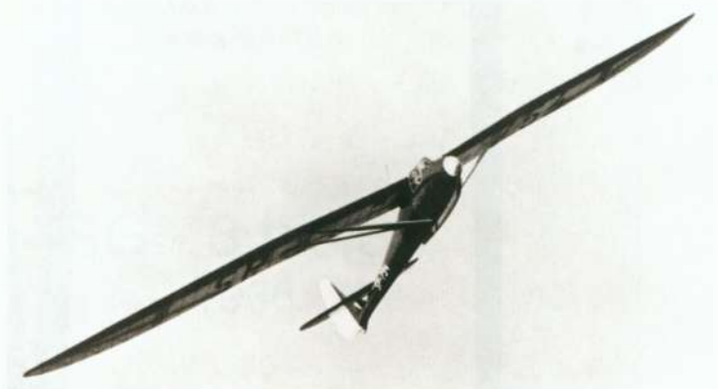
Left above: Komar bis on the airfield at Vrsac.

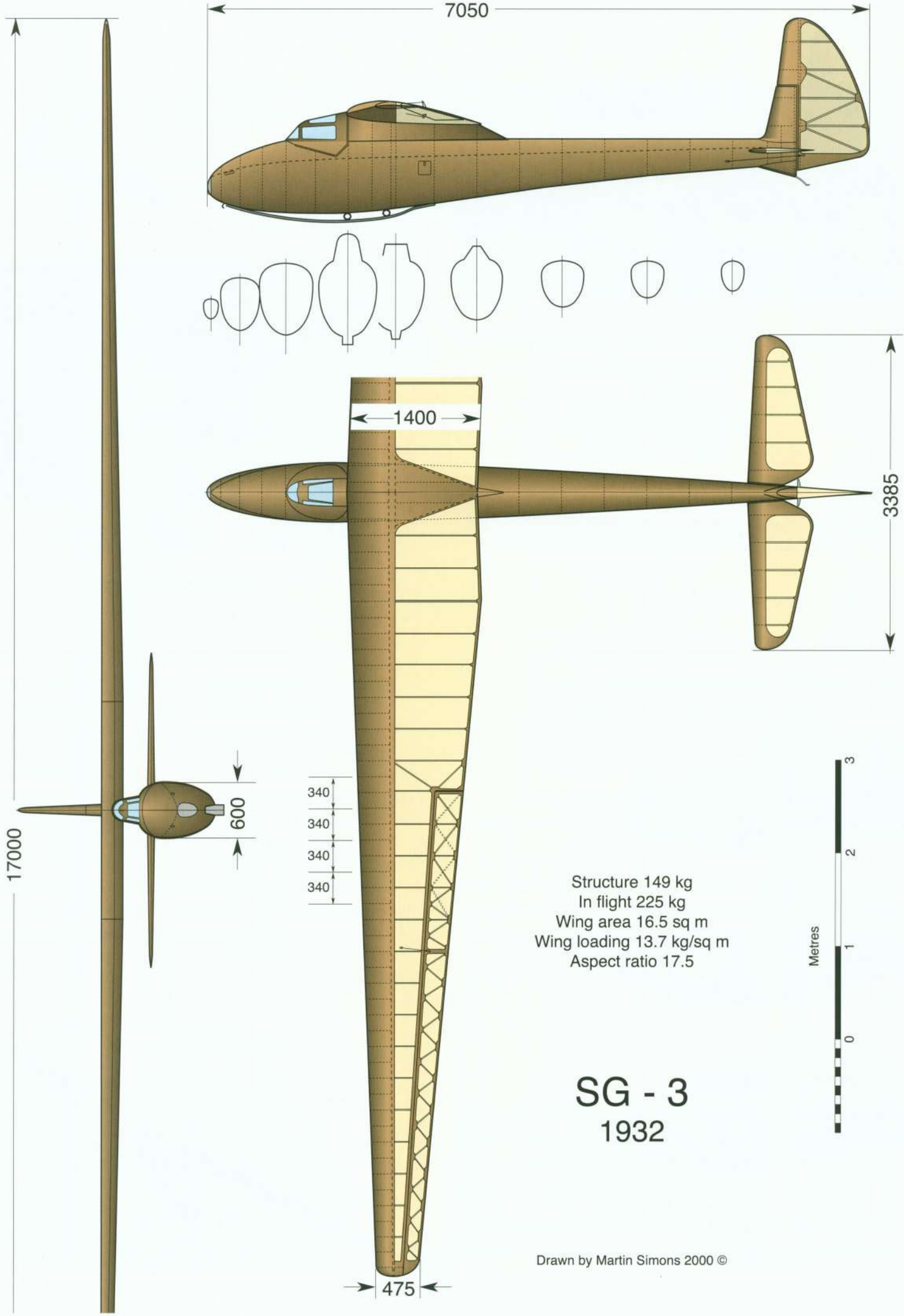
Right above: The Polish SG 28 above and below the SG - 3 bis/36.

Below on this page: The polish CW 5 bis/35.

of dihedral and a very high aspect ratio for its period, over 18. With elliptical taper of the outer panels only, the root was quite thin, leaving little room for a strong main spar. V struts were necessary. The ailerons tapered to almost nothing at their inner ends, to reduce turbulence and drag when deflected. The tail unit was particularly unusual. The all moving elevator was mounted on twin pylons, well clear of the ground, ahead of the fin. The fuselage had a high, narrow pylon to support the wing, and the cockpit was open.

The CW 5 was successful but was modified and developed to produce the CW5bis/35, which had an entirely new fuselage with elliptical cross section and a fully enclosed cockpit. This was produced in quantity and was one of the main types used in Poland for advanced flying until the outbreak of war in 1939. A single example was entered for the 1937 International Championships. The pilot, Zbigniew Zabski, made some excellent flights, placing eighth in the final list.

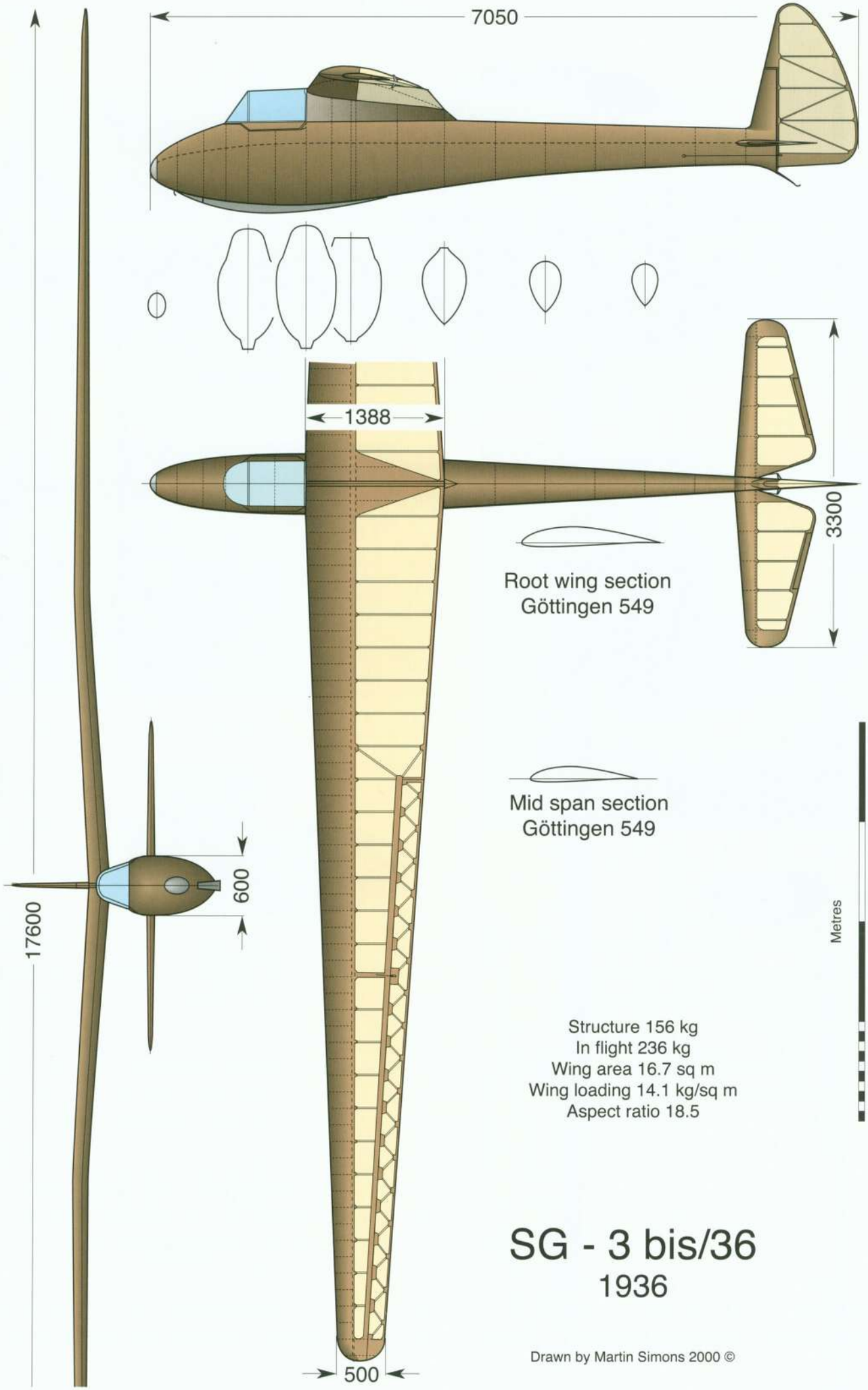




Structure 149 kg
In flight 225 kg
Wing area 16.5 sq m
Wing loading 13.7 kg/sq m
Aspect ratio 17.5

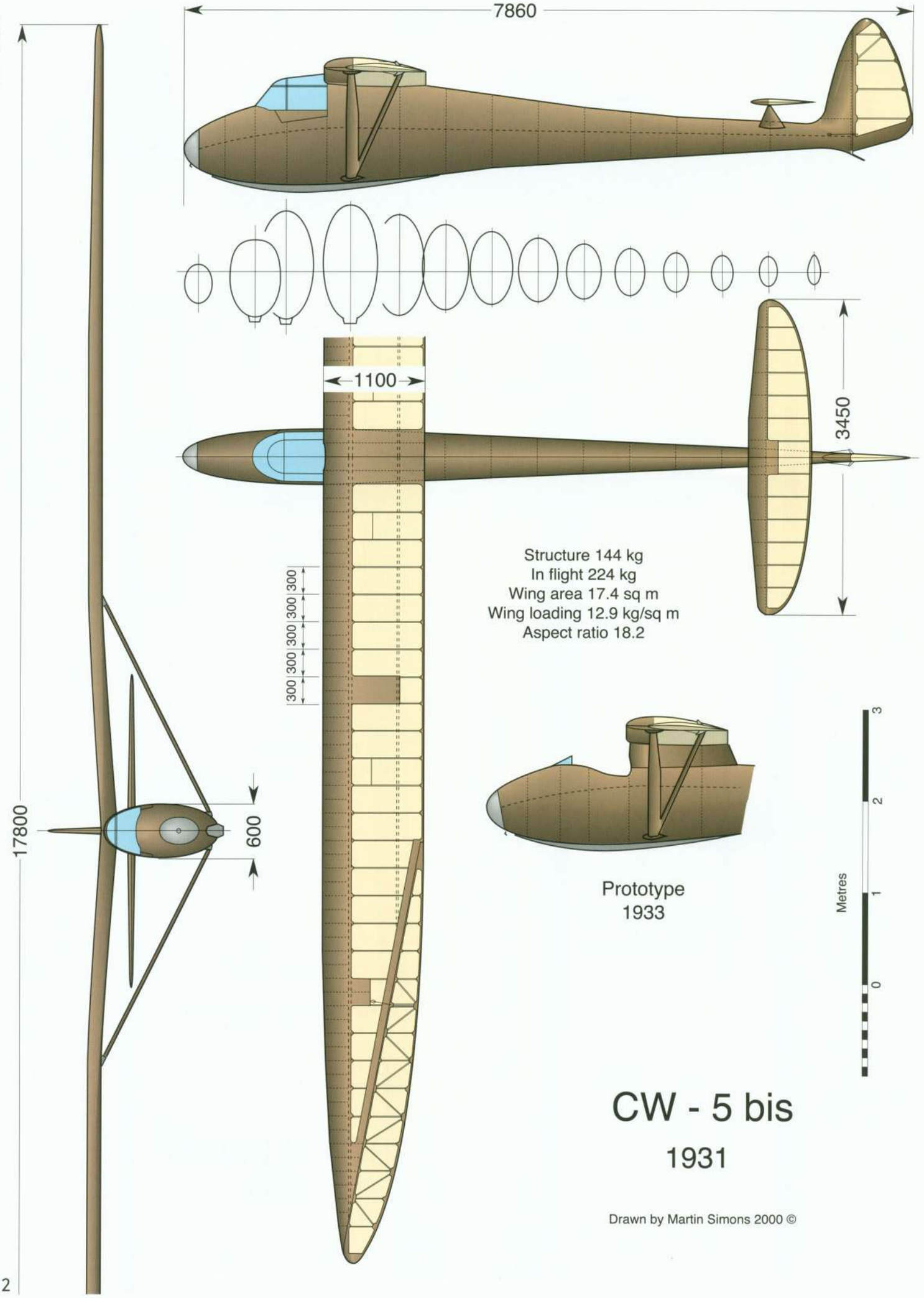
Metres 0 1 2 3

SG - 3
1932



Structure 156 kg
In flight 236 kg
Wing area 16.7 sq m
Wing loading 14.1 kg/sq m
Aspect ratio 18.5

SG - 3 bis/36
1936



CW - 5 bis

1931

Drawn by Martin Simons 2000 ©

Above: The Orlik in America, soon after arriving there.

Left: Two of the Orlik (Numbers 1 and 3) and a PWS 101 (No. 4) in line at the 1937 Internationals with a Condor and the Mü 13 (No. 20).

Right: The Olympic Orlik at Sezze.

Orlik

Unlike the other entries for the Olympic sailplane design competition in 1939, the Orlik, designed by Antoni Kocjan, had existed for some time and was already in production, well proved and successful before the sailplanes were required to assemble for judgment at Sezze in Italy. Two of the earlier version, which had span slightly less than 15 metres, were entered and flown by Baranowski and Brzezina at the 1937 International Competition in Germany and surprised everyone, especially perhaps the German pilots, by scoring very well. Baranowski made a flight over 300 km to land near Berlin and placed seventh in the final score sheet.

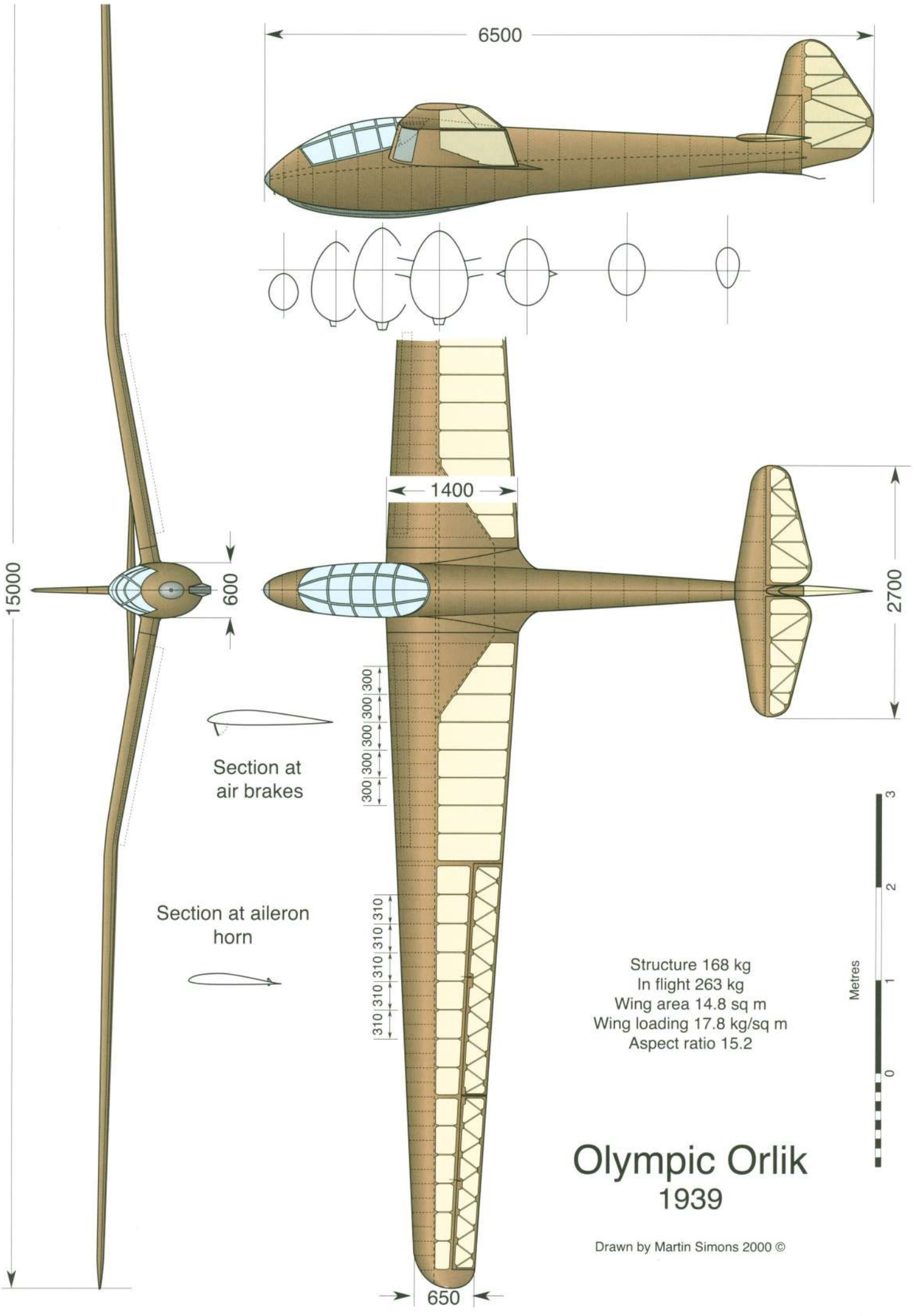
The Olympic Orlik or Orlik 3 was the full fifteen metres in span, with a carefully designed contoured canopy built up on a light metal frame. In terms of glide ratio the Orlik was almost certainly superior to the winning design, Hans Jacobs' Meise, but performance was not the main criterion for the Olympics. Everyone would be flying the same design, so a point or two off the glide would not affect the results. Construction of the Orlik was complicated by the gull wing and the mid wing mounting. In addition, the type of air brakes used, hinged to open downwards and backward under the leading edge of the wing near the root, was unfamiliar.

A single Orlik 2 was sent to the USA for the New York World Fair in 1939. It remained in the USA during the Second World War and afterwards was sold there to Paul MacCready. He used it to win the 1948 and '49 US National Championships and made a climb in wave to more than 9000 metres on the last day of 1948. This world record was broken the next day by John Robinson with a climb to 10211 metres in the RS - 1 (See below).

This Orlik 2 survives and was flown at the 1995 vintage sailplane meet at Elmira.

PWS 101

Waclaw Czerwinski moved to the PWS (Podlaska Wytwornia Samolotow, Podlasian Aeroplane Plant) as chief designer in 1937. Sailplane production was regarded as a minor interest of the compa-



Structure 168 kg
In flight 263 kg
Wing area 14.8 sq m
Wing loading 17.8 kg/sq m
Aspect ratio 15.2

Olympic Orlik
1939

ny but Czerwinski produced the PWS 101 in time for two examples to be sent to the International Competitions in 1937. They were equal to best German sailplanes and performed very well indeed. On the first day, the pilot Mynarski was one of three to achieve a flight to Hamburg, 351 km, the others being Hanna Reitsch in the new Reiher and Heini Dittmar, eventual champion, in the Fafnir 2.

Several more of the PWS 101 were built in Poland after this. In 1938 Tadeusz Gora made an outstanding distance flight of 577.8 km, which was a Polish national record and the longest flight by a sailplane in Europe that year. It was not a world record because 652 km had been achieved in the USSR by Rastourgyev in the GN - 7 (see below) the previous year.

Above: PWS 101 launched from the Wasserkuppe, 1937.

Below: PWS 101, showing the well shaped cockpit canopy.

PWS 102

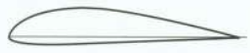
Czerwinski followed the PWS 101 with the PWS 102 Rekin (Shark) in 1939. Two prototypes were built. It was very advanced, fitted with large camber flaps over the inboard wing panels, mass balanced ailerons, and automatic coupling of all controls when rigging. Light alloys were used for the main fittings. The maximum permitted airspeed was 300 kph. Test flying was not completed before the outbreak of World War 2. The immediate occupation of the whole of eastern Poland by the USSR late in 1939, brought all sport flying and manufacture to an end. The two completed Rekins were taken to the USSR and their fate is unknown.

PWS 101
1937

Structure 270.6 kg
In flight 354.5 kg (with 50 kg ballast)
Wing area 18.9 sq m
Wing loading 18.76 kg/sq m
Aspect ratio 19

Slotted alerons
(Schematic)

Airbrakes open
(Schematic)



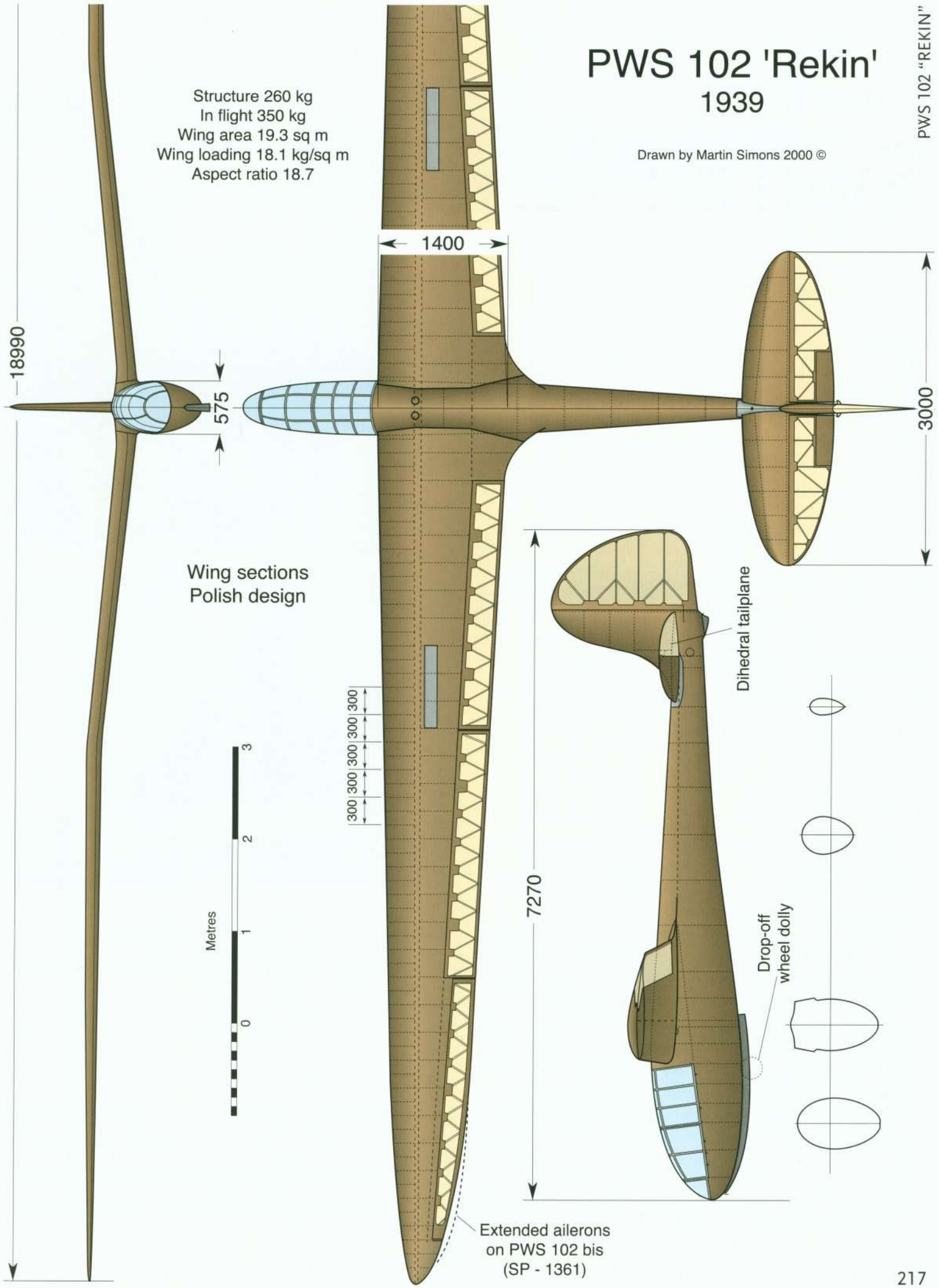
Root section
Göttingen 549
thickened to 16%

Mid span section
Göttingen 549
13.85%

Tip section
Göttingen 564
(G 549 thinned to 8%)

PWS 102 'Rekin'
1939

Structure 260 kg
In flight 350 kg
Wing area 19.3 sq m
Wing loading 18.1 kg/sq m
Aspect ratio 18.7



CHAPTER 22

Switzerland

Gliding in Switzerland developed very slowly until 1930. It was stimulated greatly by the German expeditions to the Jungfrau in 1932 and after this the movement grew steadily, with some encouragement from the government and military interest in gliding as a part of pilot training. The special conditions prevailing in the Alpine valleys required special techniques but as experience was gained, Swiss pilots became highly skilled and local designers and manufacturers were well supported.

Spalinger 15

Jakob Spalinger attended the 1920 Rhön competition and by 1930 had designed and built a dozen different gliders. The Spalinger 15 was produced in 1934. It fulfilled a role in Switzerland similar to that of the Grunau Baby and more than twenty were built. In experienced hands it proved capable of excellent soaring flights and was used for some duration record flying.

Spalinger 18

Spalinger produced the first S - 18 in 1936. It was a relatively small sailplane with moderate performance but handled well and was capable of development. Two were taken to Berlin to participate in the competition there in parallel with the Olympic Games.

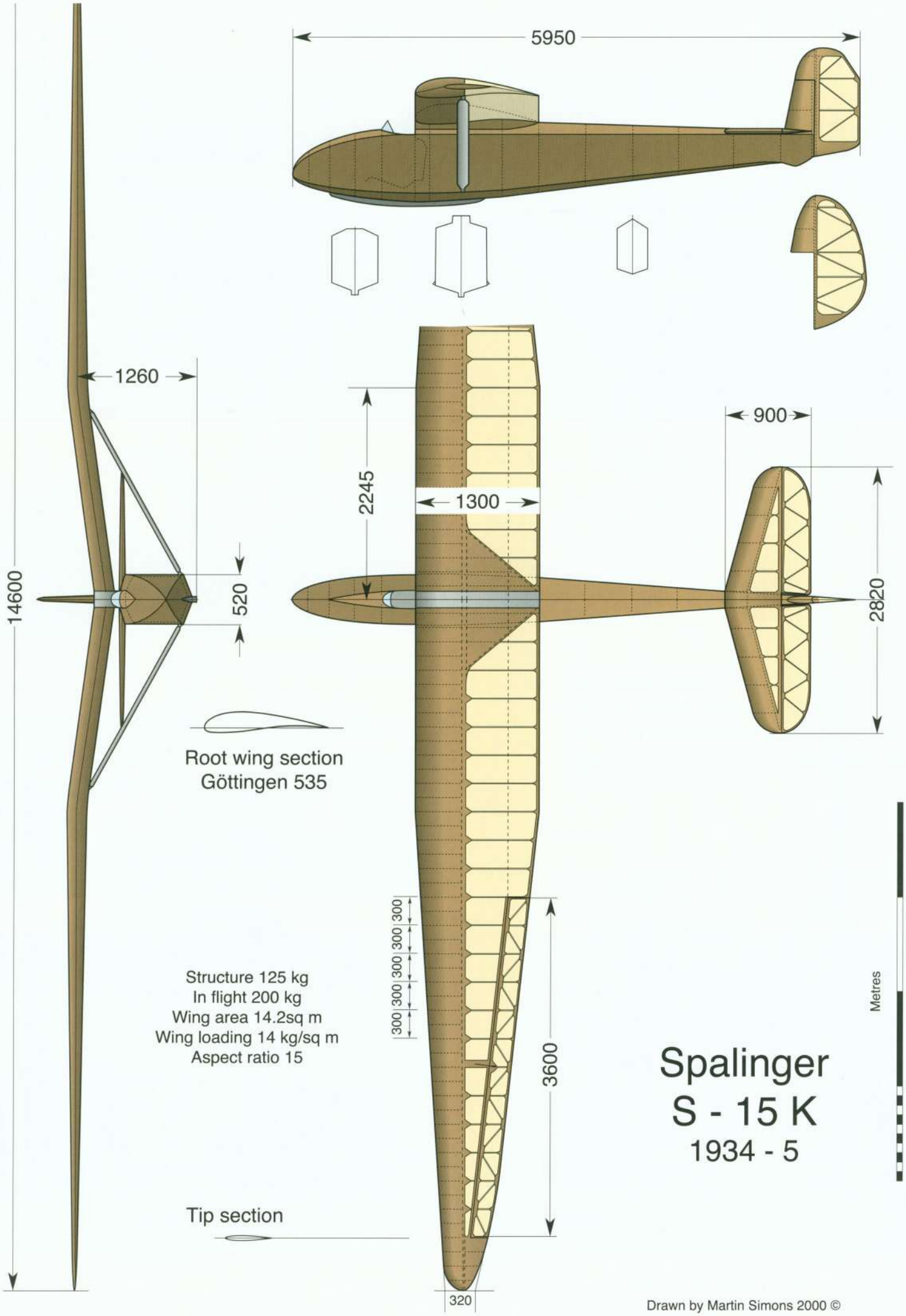
The S - 18 - II with a larger span and other detailed improvements came in 1937. Using plans supplied by Spalinger, Herman Schreiber built the S - 18 T Chouca. This was a Spalinger 18 with additional dihedral for the sake of improved stability in circling flight. It competed in the 1937 Internationals in Germany, where it did well. Production of the S - 18 - II continued and the type became dominant in Swiss competitions and record flying. About 25 were built, after which the S - 18 - III, with air brakes and a contoured canopy, appeared. In one of these the French pilot, Eric Nessler, broke the world duration record with 38 hours, 21 minutes. Other versions of the S - 18 were developed, including an aerobatic model with reduced span, before Spalinger went on to design the S - 19, 21, 22 and others. He was awarded the FAI Tissandier Diploma in 1969, for his work in the development of soaring.

Above: The S - 15 was extensively used for alpine soaring and cross country flying.

Below: The Spalinger S - 15 was an original Swiss design intended for the same roles as the Grunau Baby.

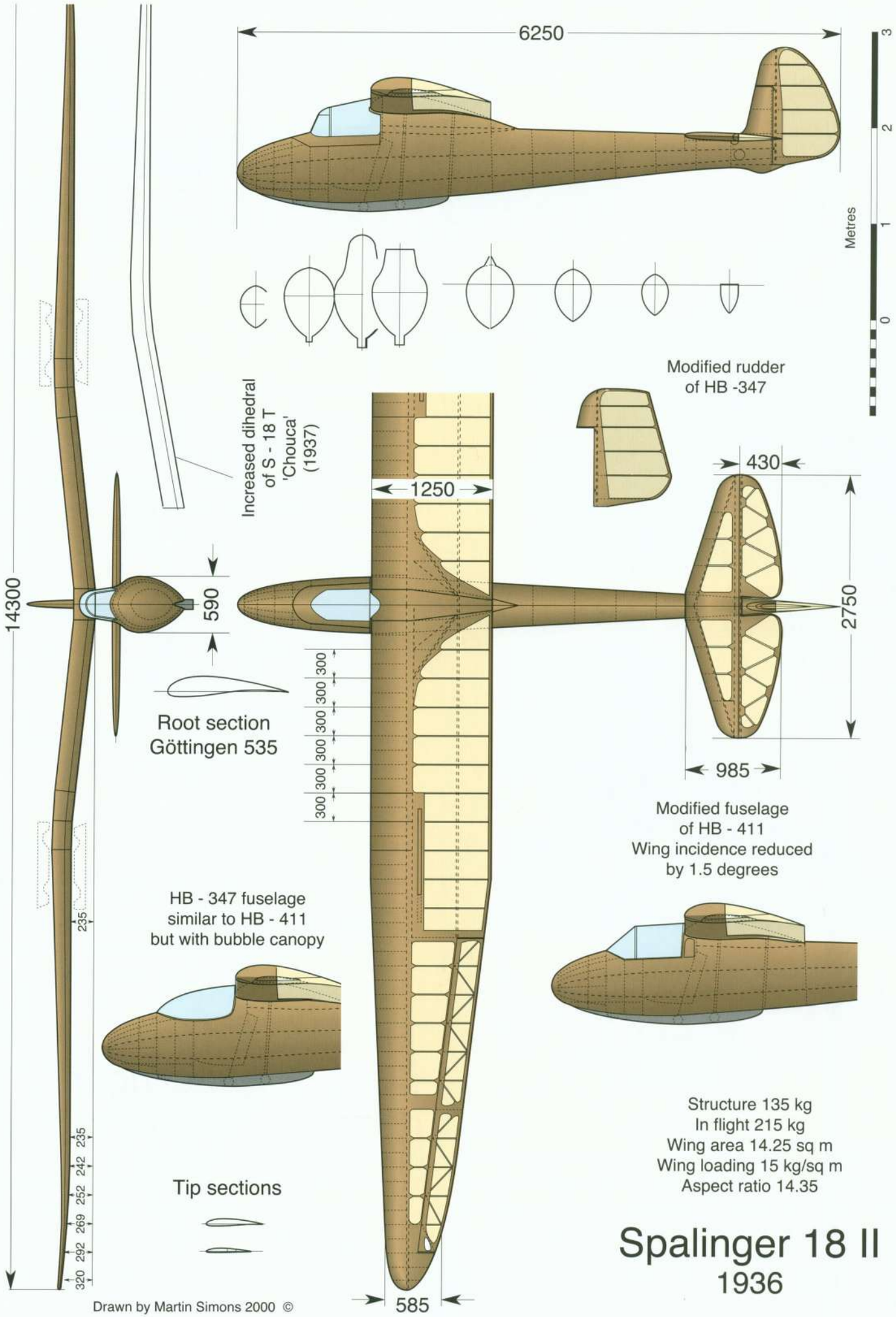
Spyr 3

August Hug built the Spyr 1, a fifteen metre single seat sailplane, in 1931. It was flown with success by Willi Farner, taking off from the Jungfraujoch. Two were completed. The Spyr 2 was found to be over sensitive in flight and had a tendency to tail flutter. Hug abandoned it and designed the Spyr 3 which, although still somewhat tricky to fly, was much more successful. Two of the four sailplanes taken by



Structure 125 kg
In flight 200 kg
Wing area 14.2sq m
Wing loading 14 kg/sq m
Aspect ratio 15

Spalinger S - 15 K
1934 - 5


6250
Metres
0
1
2
3
Modified rudder
of HB -347
Increased dihedral
of S - 18 T
'Chouca'
(1937)
1250
430
2750
985
14300
590
300
300
300
300
300
300
Root section
Göttingen 535
Modified fuselage
of HB - 411
Wing incidence reduced
by 1.5 degrees
HB - 347 fuselage
similar to HB - 411
but with bubble canopy
235
235
242
252
269
292
320
Tip sections
585
Structure 135 kg
In flight 215 kg
Wing area 14.25 sq m
Wing loading 15 kg/sq m
Aspect ratio 14.35
Spalinger 18 II
1936
Drawn by Martin Simons 2000 ©

Above: Sparlinger S18T 'Chouca' in the Rhön with Marcel Godinat, 1937.

Above: The Special Spalinger 18T, 'Chouca', with extra dihedral, at the Internationals in 1937

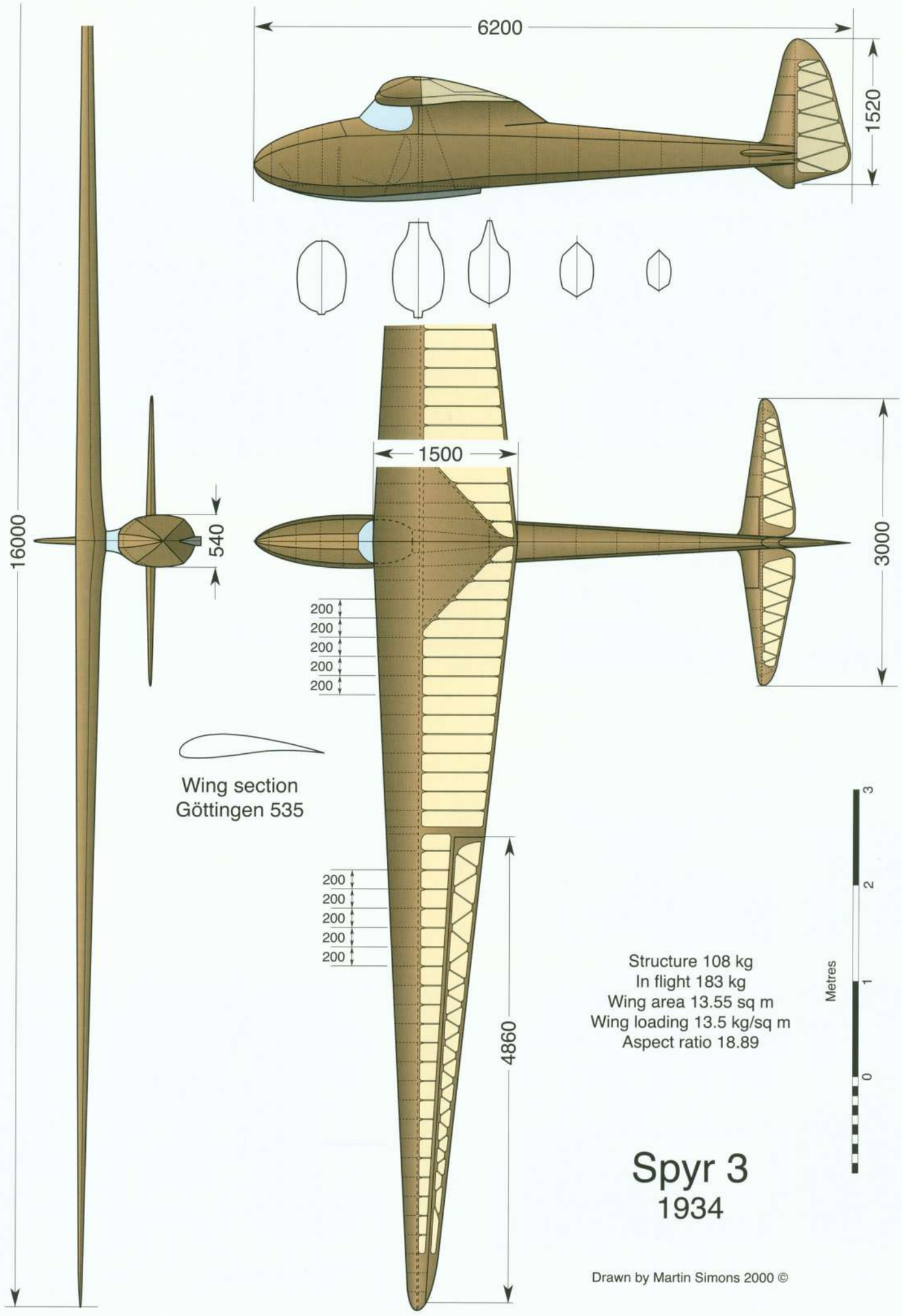
the Swiss team to the 1937 Internationals, were Spyr 3s. Sandmeir, the most experienced of the four pilots, finished fourth in the final scores, an outstanding achievement against the Germans in their much larger and more refined aircraft.

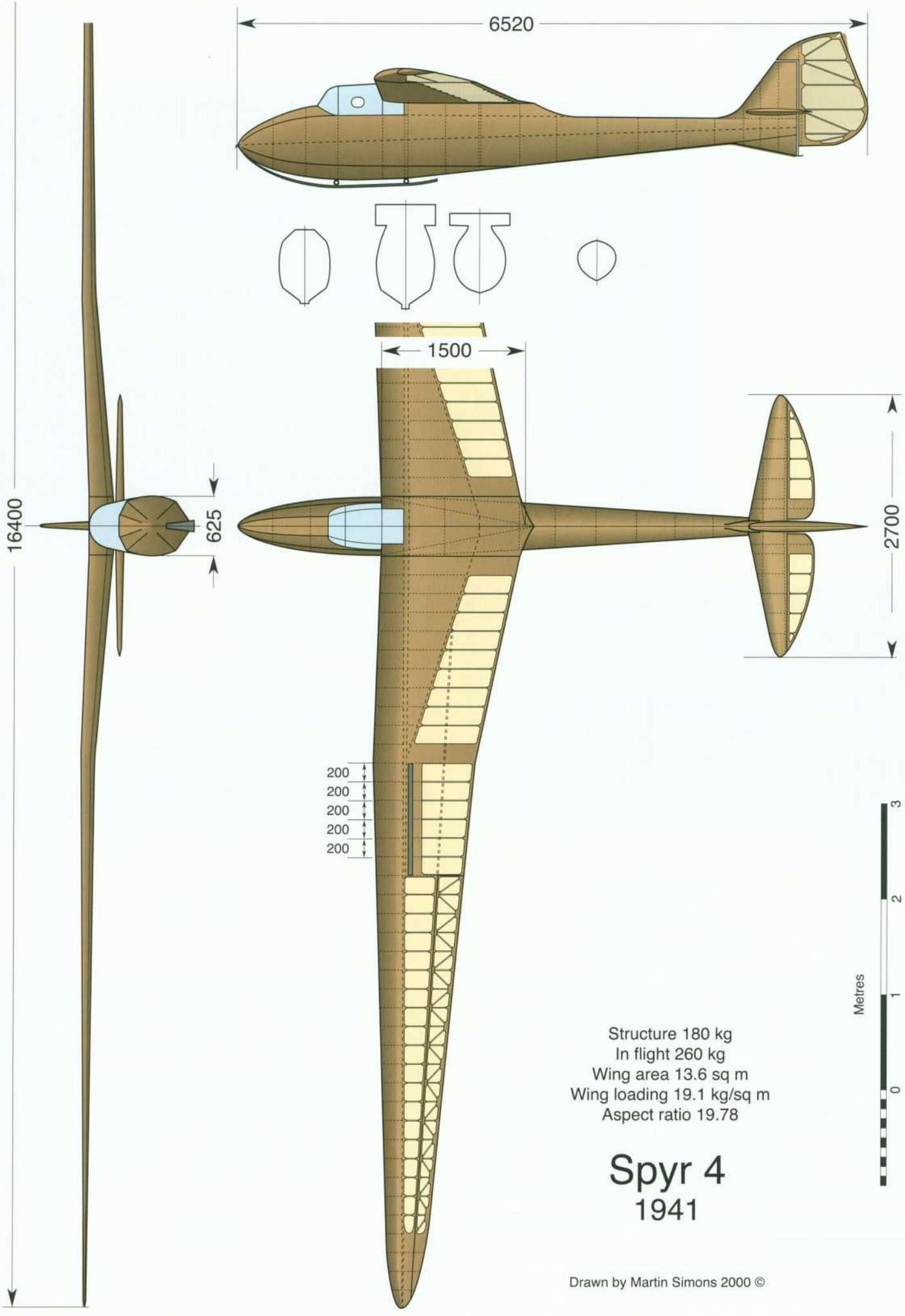
Spyr 4

The Spyr 4, flown in 1941, was larger, heavier and faster than Hug's previous design and, with its swept forward gull wing, was greatly admired. It handled well and if political conditions had been more favourable, might have proved itself a good cross country sailplane. In fact very few were built.

Left: A standard Spalinger 18 - 1

Below: The Spyr III on the Jungfraujoch in 1935. Snow and high altitude made operations difficult.


6200
1520
16000
540
1500
3000
200
200
200
200
200
Wing section
Göttingen 535
200
200
200
200
200
4860
Structure 108 kg
In flight 183 kg
Wing area 13.55 sq m
Wing loading 13.5 kg/sq m
Aspect ratio 18.89
Metres
0
1
2
3
Spyr 3
1934
Drawn by Martin Simons 2000 ©



Structure 180 kg
In flight 260 kg
Wing area 13.6 sq m
Wing loading 19.1 kg/sq m
Aspect ratio 19.78

Spyr 4
1941

Right above: The Moswey 2, restored to fly in recent times.

Left below: The Moswey 3.

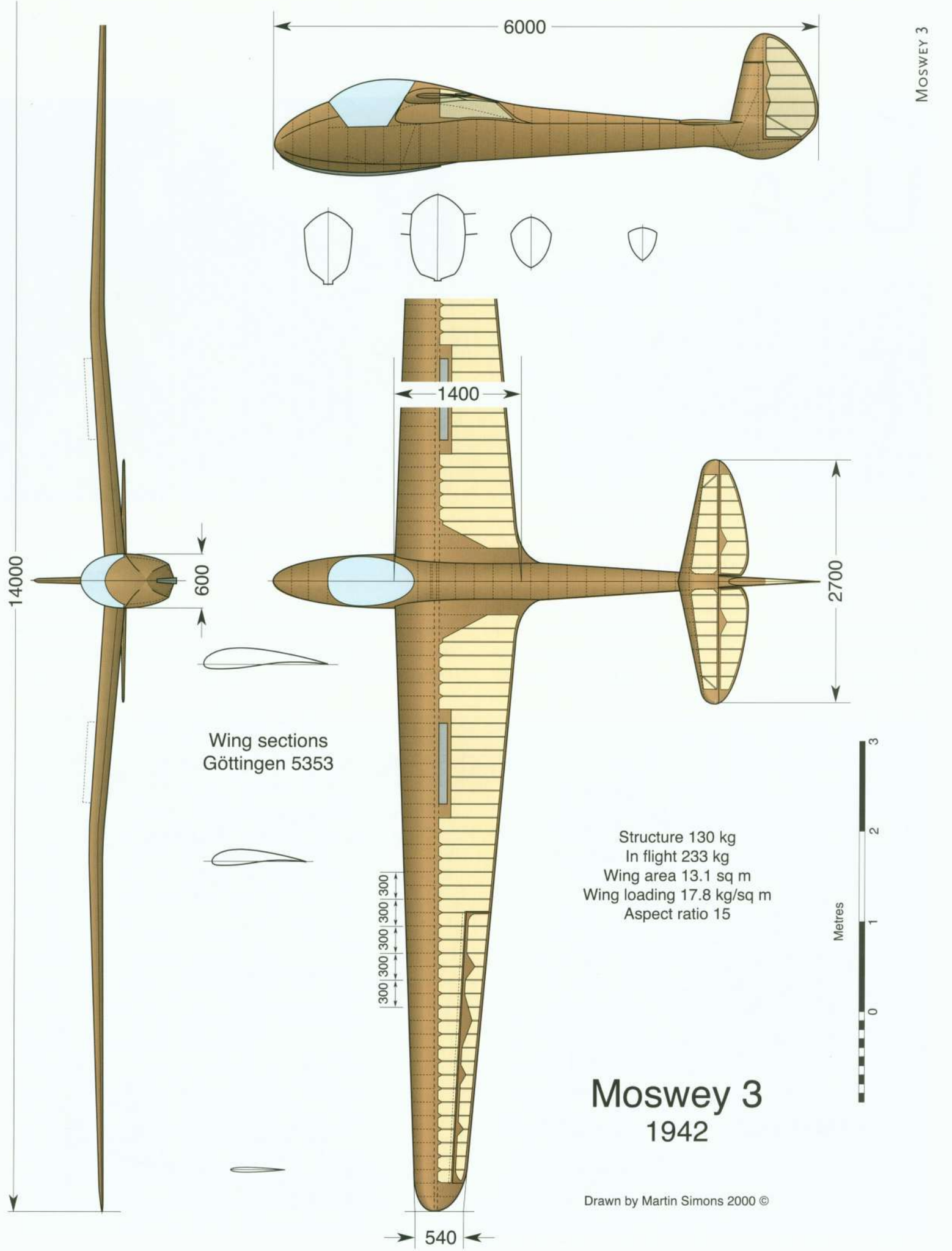
Right below: The Moswey 2A had the wing span extended to 15.5 metres.

Moswey

The Moswey sailplanes began in 1930 with the Moswey 1 which was a primary glider, built by the brothers Müller. They worked for some years building sailplanes for August Hug but in 1935 Georg Müller alone designed and built his Moswey 2. It was a very neat, small sailplane which performed and handled well. It was stressed to a 'g' factor of 12 and was aerobatic. The very high standard of workmanship achieved by Müller was greatly admired and distinguished all his later products. The metal fittings in particular were made with utmost precision and fitted like the parts of a high class watch. The woodwork was equally good. One of the Swiss sailplanes entering the International Competitions in 1937, was the Moswey 2 flown by Heiner Müller.

The Moswey 2A of 1939 had the span increased to 15.5 metres, with an improvement in performance but some deterioration in handling. It was followed in 1942 by the Moswey 3, which reverted to a smaller span. There were various detailed improvements, including a moulded cockpit canopy in two halves joined on the centre line, and improved fairing at the wing root. The type went into production after 1945. Fourteen were built. The first world record for speed round a 100 km triangle was set by Sigbert Maurer.

Two or three of the Mosweys and a post war version, the Moswey 4, survive.



Moswey 3
1942

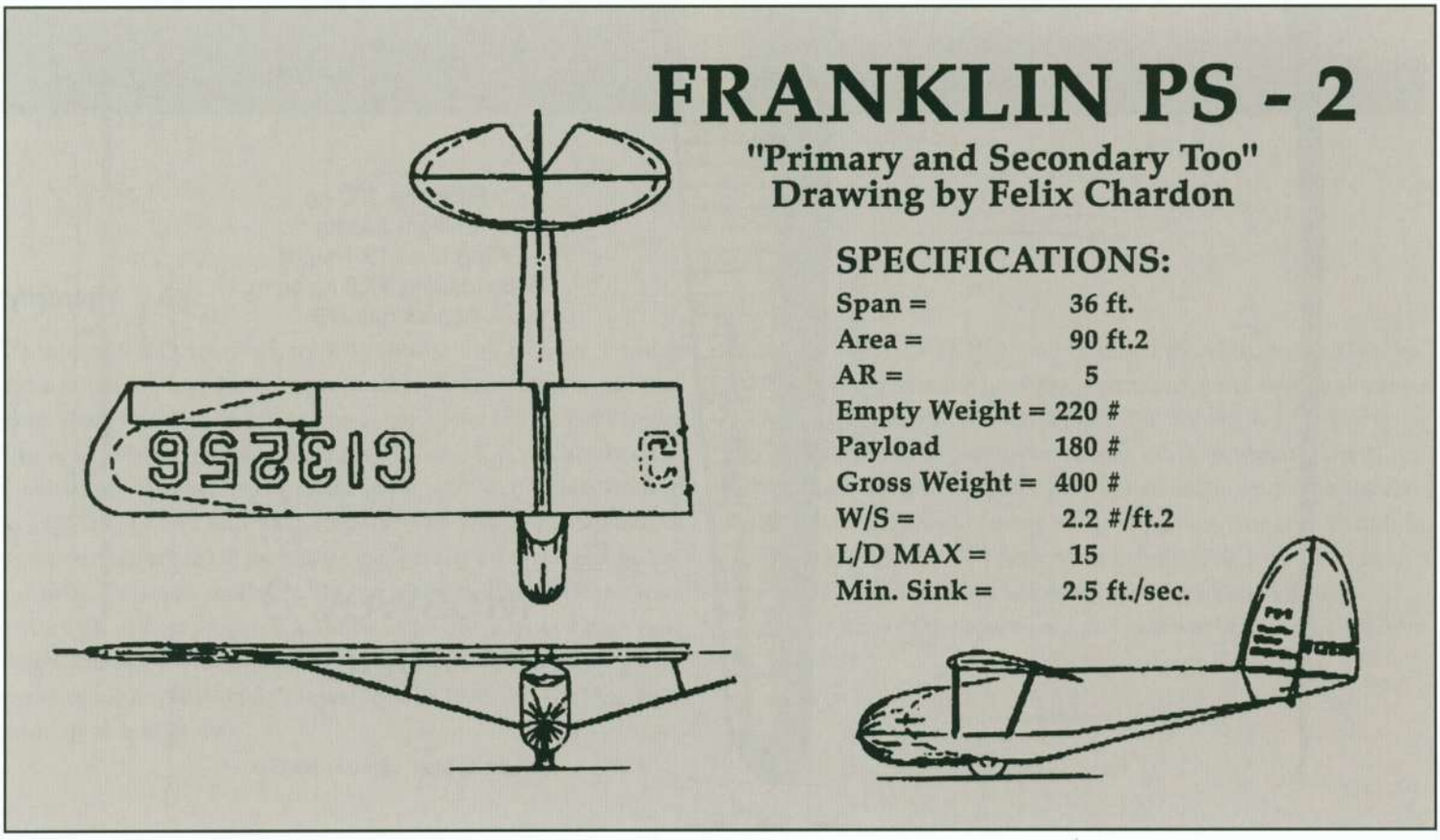
CHAPTER 23

USA

The Franlin PS - 2 launched at Elmira, New York.

The Wright Brothers flew gliders at Kitty Hawk in order to solve the problems of controlling an aircraft before they ventured to instal a power plant. Their success in flying the first aeroplane in 1903, is largely due to these early gliding trials. Apart from one brief season in 1911 when Orville returned to the sand dunes to fly a glider again, with some soaring, there was little interest in the USA in gliders, except for a handful of enthusiasts like Hawley Bowlus (see below).

The visit of Peter Hesselbach with the Darmstadt and Prüfling sailplanes to Cape Cod in July 1928, aroused interest, with front page stories in national newspapers. The National Glider Association was formed early in 1929, with ambitious plans. In June of that year an article 'On the wings of the wind' by Howard Siepen was published in the National Geographic Magazine, describing the developments in Germany. The arrival from Germany of Wolfgang Klemperer was a further important stimulus. Ralph S Barnaby soared the imported Prüfling for fifteen minutes over the Cape Cod dunes in August 1929, the first American to achieve the 'C' soaring badge.



The Bowlus Albatross owed something the Wien but had many original features.

The Franklin PS – 2

Many gliding clubs in the USA, as elsewhere, began in the late nineteen twenties by building primary gliders from German plans. Local amateurs and some professional producers modified the design in various ways but the basic principles were not changed at first.

Dissatisfaction with German methods was soon felt. The objections were not to solo training as such but to the bungee launching method requiring a hill site and so much hard physical work with such slow progress. The auto towed launch from flat ground was adopted before it was used in Europe. The Americans also used aero towing. An earlier Franklin glider, the 50 foot span Texaco Eaglet, was towed by a WACO 10 aeroplane in stages across the continent from San Diego to New York as early as 1930. For both methods of operation, and for easier handling of the glider on the ground, a wheel was essential.

An influential article in the November Aero Digest by A P Artran, President of the Franklin Glider Corporation, set out the arguments and announced the development of a new glider, intended for basic training and yet capable of soaring and aerobatics. This was the Franklin PS – 2, standing for ´Primary and Secondary too'. The designer was R E Franklin.

The span was a modest 36 feet. It was a very robust glider with steel tube framed, fabric covered fuselage and a wheel. The wooden wings, of two spar construction, were braced with struts rather than the numerous wires of the Zögling. Rigging and de-rigging were much easier. The structure was very light to keep the flying speed low. For early ground slides and hops the seat could be fully exposed like an orthodox primary glider but a light fairing was usually fitted to enclose the pilot and improve the airflow.

The Franklin proved itself fully up to expectations and was very popular. Some 54 were built, by far the largest number of any single type of glider in the USA at that time. They were used not only for training but for aerobatic displays and trials with the so-called Lustig Sky Train, which was intended to demonstrate the practicality of using gliders to transport goods and mails. Three Franklins were towed together in line astern, to release in sequence to glide down to their various destinations. The idea did not catch on.

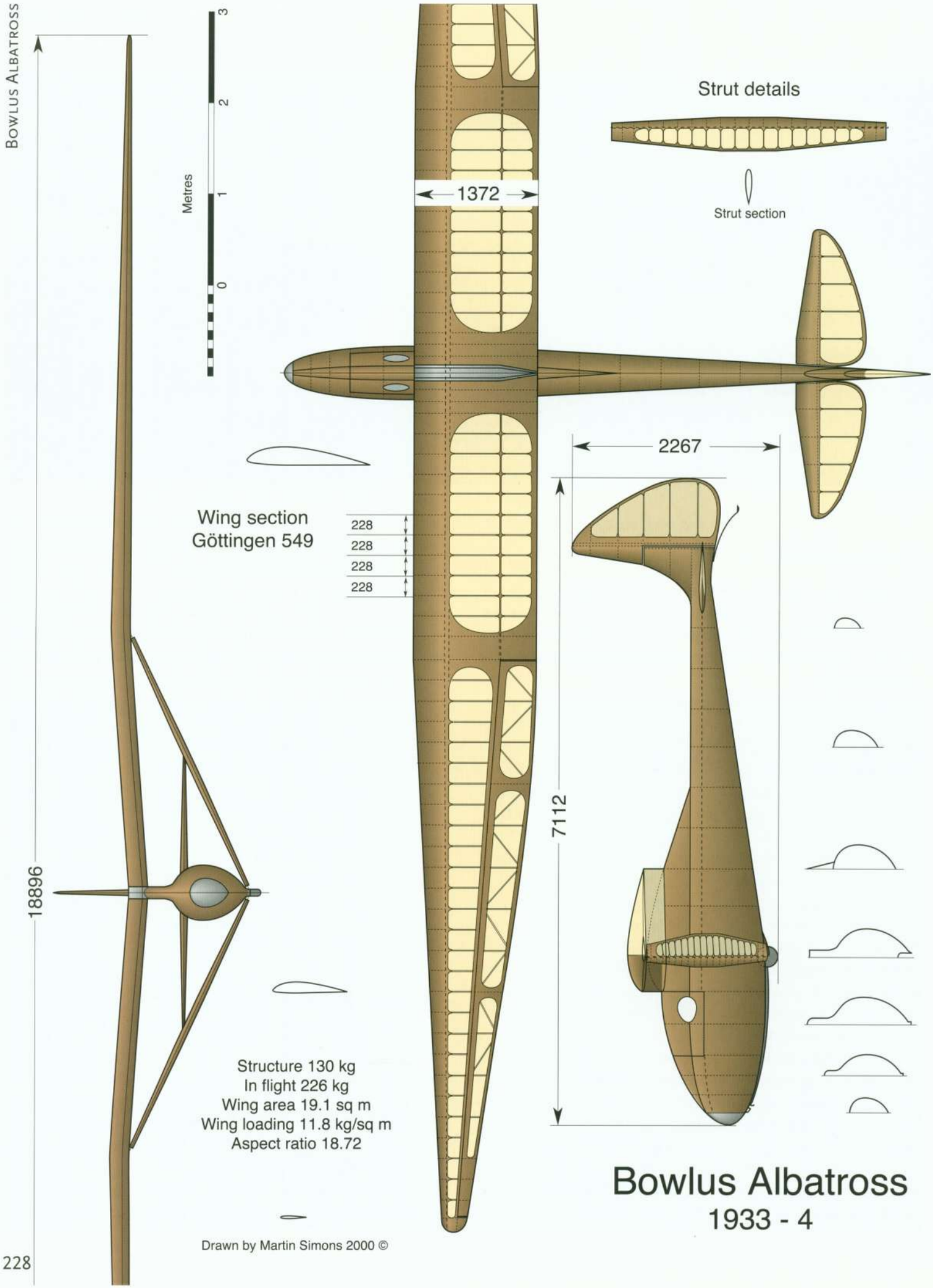
It was a Franklin PS – 2 piloted by Jack O`Meara that flew over New York City in 1930, a few weeks before Wolf Hirth`s soaring flight after a bungee launch from the banks of the Hudson (See Chapter 2), and Stan Smith won the National Soaring Championship in 1933 with a PS – 2.

Only one PS – 2 survives in flying condition now. It was restored by Charles Franklin, Joe Feather, Jack and Dorothy Wyman in time for the 1995 Vintage Glider Meet at Elmira.

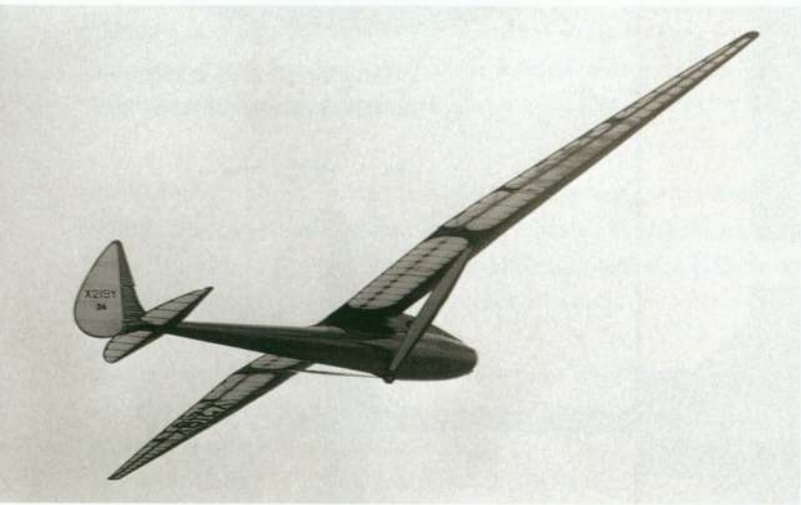
Bowlus Albatross

Hawley Bowlus, born in 1896 in Illinois, built and flew a glider modelled on a Wright Brothers type in 1912. He moved to the west coast. His interest in gliding was revived by the news from Germany and in October 1929 he became the second American citizen to achieve the 'C' soaring badge, flying a 14.3 metre span sailplane of his own design and construction. He followed this with a US record duration of one hour, twenty minutes.

In 1930 he visited Elmira for the first US National Soaring Contest and met Gus Haller, Wolf Hirth and Martin Schempp who were at



Bowlus Albatross
1933 - 4



Left above: Portholes for the pilot were considered adequate.

Right above: The cockpit layout was unorthodox, with a type of 'handle bars' for lateral control. The instrument panel was verical.

Below: The Bowlus Albatross soaring.

this time associated in the Haller Hirth Sailplane Manufacturing Company. With Hirth, in 1931 Bowlus started a training school using auto towed launches, a method invented in the USA. It enabled training flights, and soon thermal soaring, to be done from flat ground.

The training school closed when Hirth went back to Germany, taking these new ideas with him. Bowlus returned to California where he designed and built, with the aid of students from the Curtiss Wright Technical Institute, the Bowlus Super Sailplane. This was strongly influenced by the Wien, with similar aerofoil sections and general arrangement, single spar wing with plywood skinning, but Bowlus was not content to make a slavish copy. The wing, in two pieces, had a rectangular centre section with the tips tapering, but with a slightly curved outline to the ailerons to come closer to the ideal elliptical form. On this prototype there was no dihedral.

To have a wheel on a glider was unusual in Europe but when cars were used to move the new generation of large and heavier gliders about on the ground, wheels were almost a necessity. Wheeled dollies and carts were used, but these had to be removed before flying and replaced after landing. (The idea of a 'drop off' dolly came later.) In the USA, towing gliders with aeroplanes was becoming quite common, while in Germany still this was regarded with distrust. It had been done as early as March 1927 by Gerhard Fieseler and Gottlob Espenlaub as a stunt in air shows. For the glider to take off behind an aeroplane or tow car, a proper undercarriage was a sensible development. The earliest American 'primary' and 'secondary' sailplanes such as the Franklin PS - 2 usually had wheels.

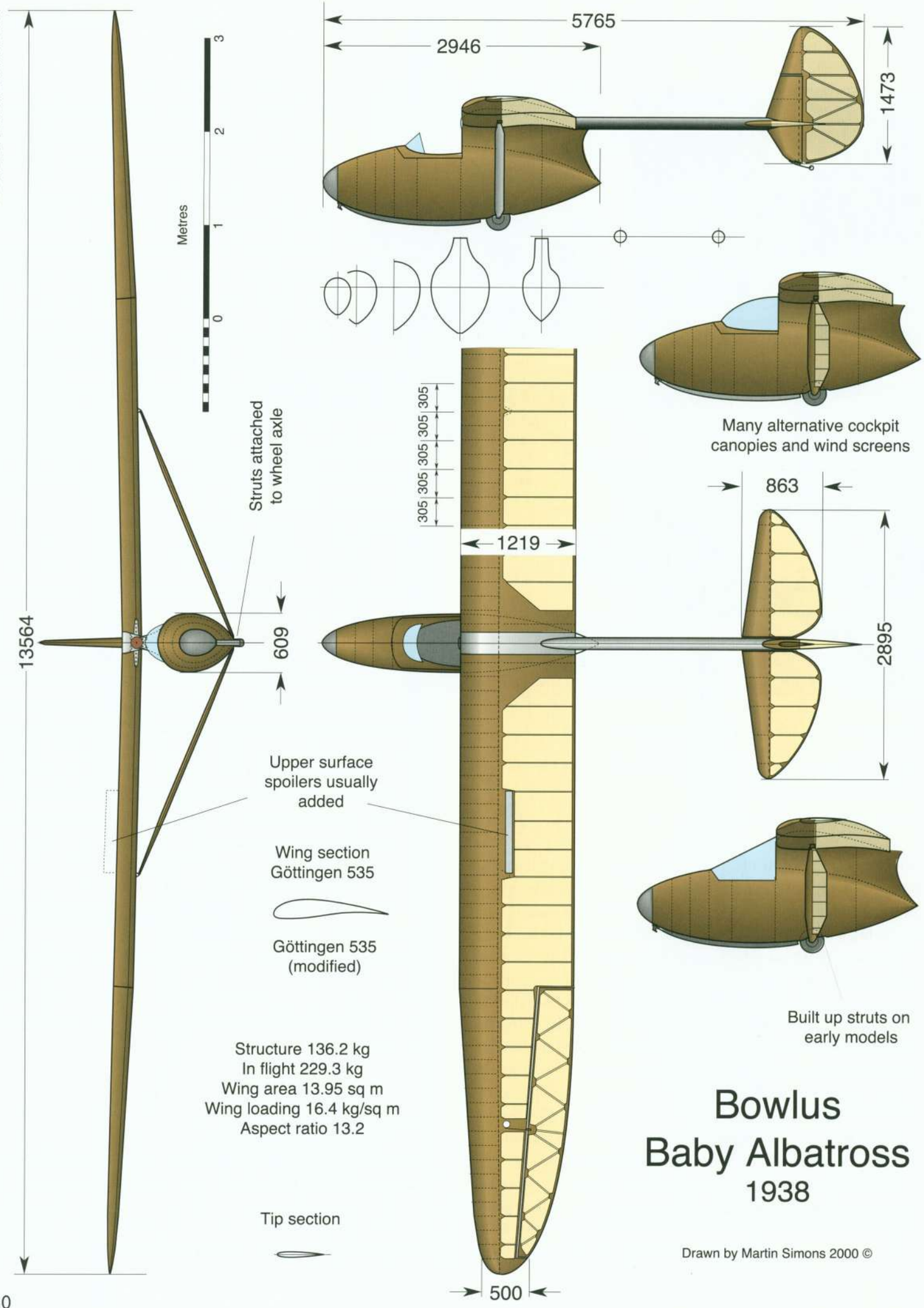
Bowlus was the first designer to fit a wheel on a high performance sailplane. Instead of V struts there was a single strut which, at the lower end, was attached to the wheel bearing plates rather than to separate fittings on the main fuselage cross frame. The struts were much wider in chord than usual, with a streamlined cross section built up like a small wing with fabric covering. Like the Musterle, which Bowlus had seen at Elmira, the cockpit was fully enclosed and faired with a plywood canopy , except for portholes at the sides.

Warren Eaton, a founder member of the Soaring Society of America, ordered a sailplane from Bowlus and the Albatross 1, christened Falcon, was built, with slightly more span and this time with a 'gull' wing. The structure was strengthened. Bowlus fitted split trailing edge flaps under the inner wing as a landing aid. The plywood skinning was not birch as in Europe but mahogany which, when varnished, gave the Falcon a dark, reddish colour and a luxurious appearance. Richard Dupont ordered the Albatross 2, which was completed without the flaps and skinned with spruce ply. In his new aircraft Dupont took off from Harris Hill, Elmira, on 25th June 1934, soared in thermals eastwards until within sight of New York city. He landed after 247 kilometres, a world distance record although technically disallowed because it did not exceed the previous figure by the requisite 5%. Later Dupont set the US height record at 1897 metres and became the second American to gain the Silver C badge, No. 32 on the international list (after Jack O'Meara, No 12). In 1935 he won the American Championship again in the Albatross, which was then sold to Chester Decker who became Champion with it the following year.

Both these sailplanes survive, Falcon in the Smithsonian collection and Albatross II at Harris Hill in the National Soaring Museum. Bowlus built more of the Albatross type but how many actually were completed is not certain. Efforts to restore at least one have been made.

Baby Albatross

The Bowlus Baby Albatross first flew in 1938. It was intended from the beginning as a kit sailplane to be assembled by amateurs. The wing was essentially the same as the Grunau Baby 2. The fuselage and tail unit were highly original. A streamlined pod was moulded in mahogany plywood as a shell to contain the cockpit, and a light



Structure 136.2 kg
In flight 229.3 kg
Wing area 13.95 sq m
Wing loading 16.4 kg/sq m
Aspect ratio 13.2

Bowlus Baby Albatross 1938

The Bowlus Baby Albatross was virtually a Grunau Baby wing with a highly original pod and boom fuselage and tail. It was produced in kit form and about 100 were sold, but not all were completed. After restoration, several are now flying in the USA.

metal tubular boom carried the tail. Like the larger Albatross, the struts were of aerofoil section and the elevator of the all moving type. The kits were well thought out and complete, the pod being supplied in two halves, the spars, frames, ribs and metal parts ready for assembly.

Advertised at an attractive price, more than 100 kits were sold and many were completed and flown. Many others were never finished and very few remain in service.

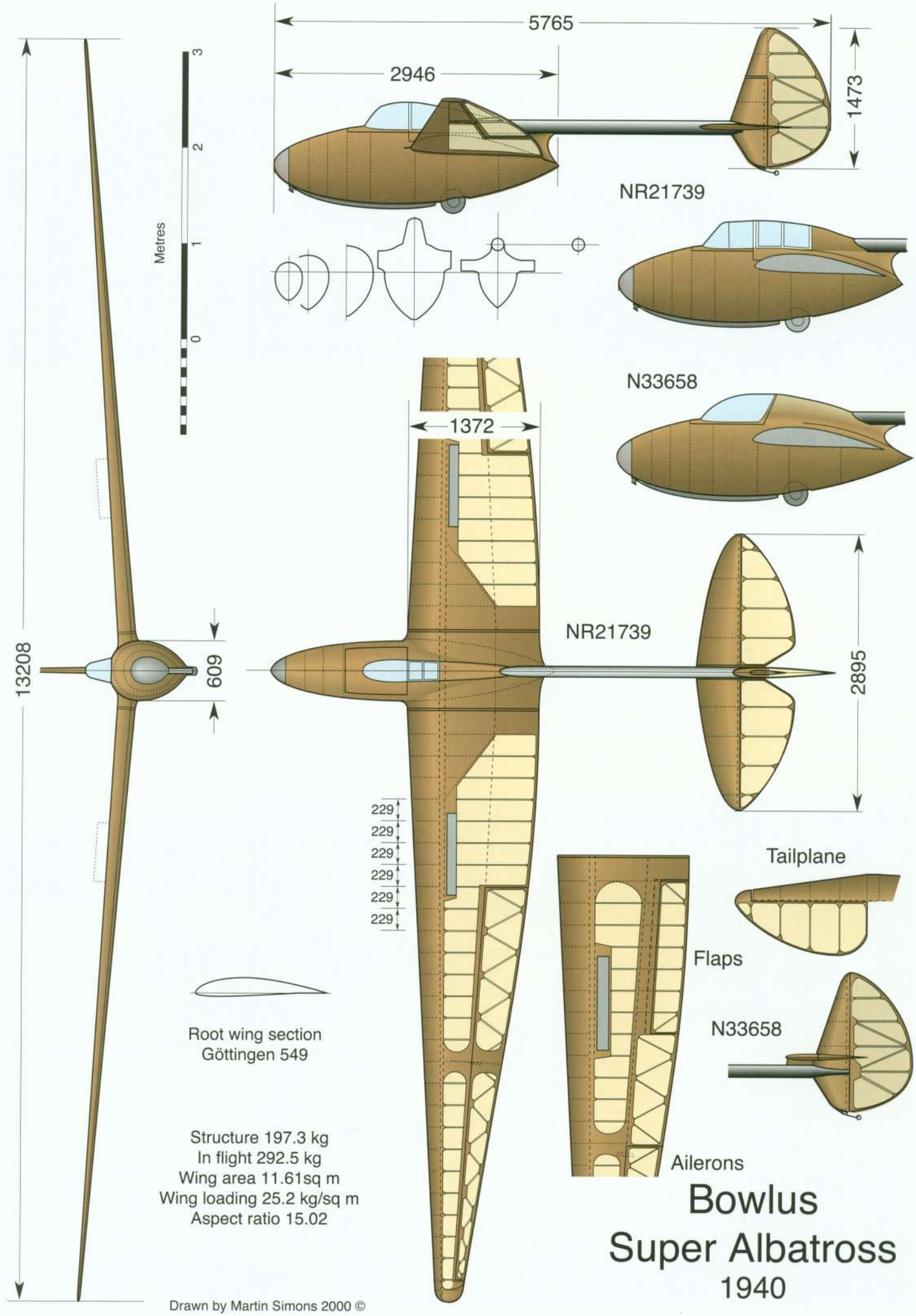
Bowlus built a two seat version of the Baby Albatross, and there was also a successful motorised development, but neither entered quantity production.

Super Albatross

The Super Albatross was a combination of two very different sailplane designs. The moulded shell pod, alloy tail boom and tail unit were adapted from the Baby Albatross. The wing was taken from the outer panels of the original 18.9 metre Albatross. Necessary changes were made to allow the various components to be combined safely. Bowlus himself built the prototype, which had the all moving elevator of the Baby and large flaps for landing and approach control. Spoilers were added later. A second Super Albatross was built by Howard Kelsey, which had a tailplane and elevator of elliptical plan and no flaps.

Both these aircraft survive, but not in airworthy condition.

The Super Albatross was a development of the Baby Albatross. Two were built, with different tailplanes.



Bowlus Super Albatross 1940

Above: The back view of the Super Albatross.

Laister Yankee Doodle

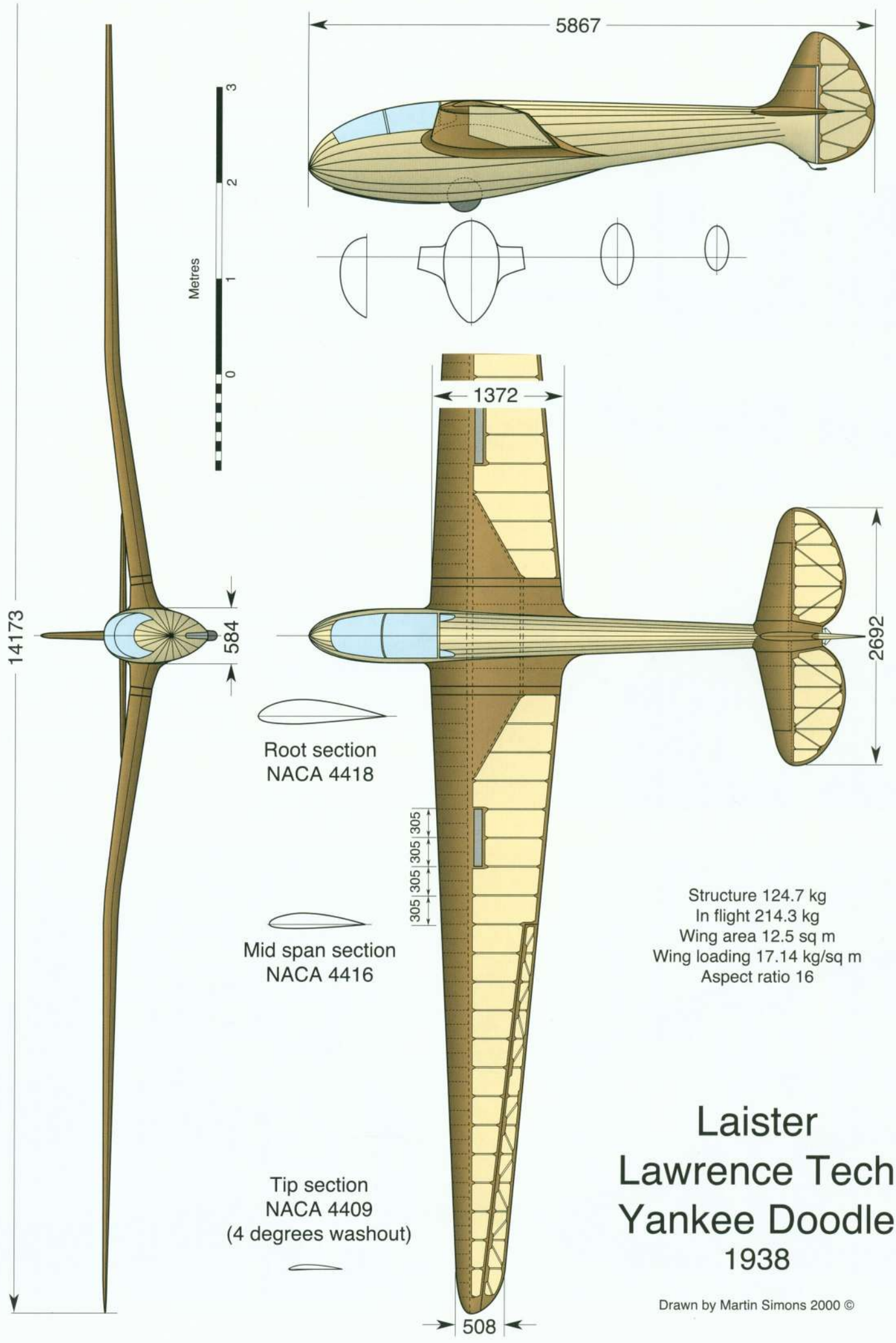
Jack Laister was a student at the Lawrence Institute of Technology in Michigan in 1935 and with financial support from the college designed and built his own single seat sailplane. This, called at first the Lawrence Tech Sailplane, had a wooden, tapered, gull wing with spoilers, a steel tube framed fuselage of good aerodynamic shape with light wooden stringers and fabric covering, a contoured cockpit canopy and landing wheel. The wing profiles were from the NACA 4 digit series, 4% cambered, thinning from 18% at the root to 9% at the tip. Painted in spectacular red white and blue fashion, the sailplane was renamed Yankee Doodle and taken to France to perform aerobatics in an air show conducted by the Paris Aero Club. It was slightly damaged in a landing mishap and returned to the USA for repair and further flying.

Both below: Jack Laister's Lawrence Tech sailplane, later called 'Yankee Doodle'.

LK - 10 A (TG - 4A)

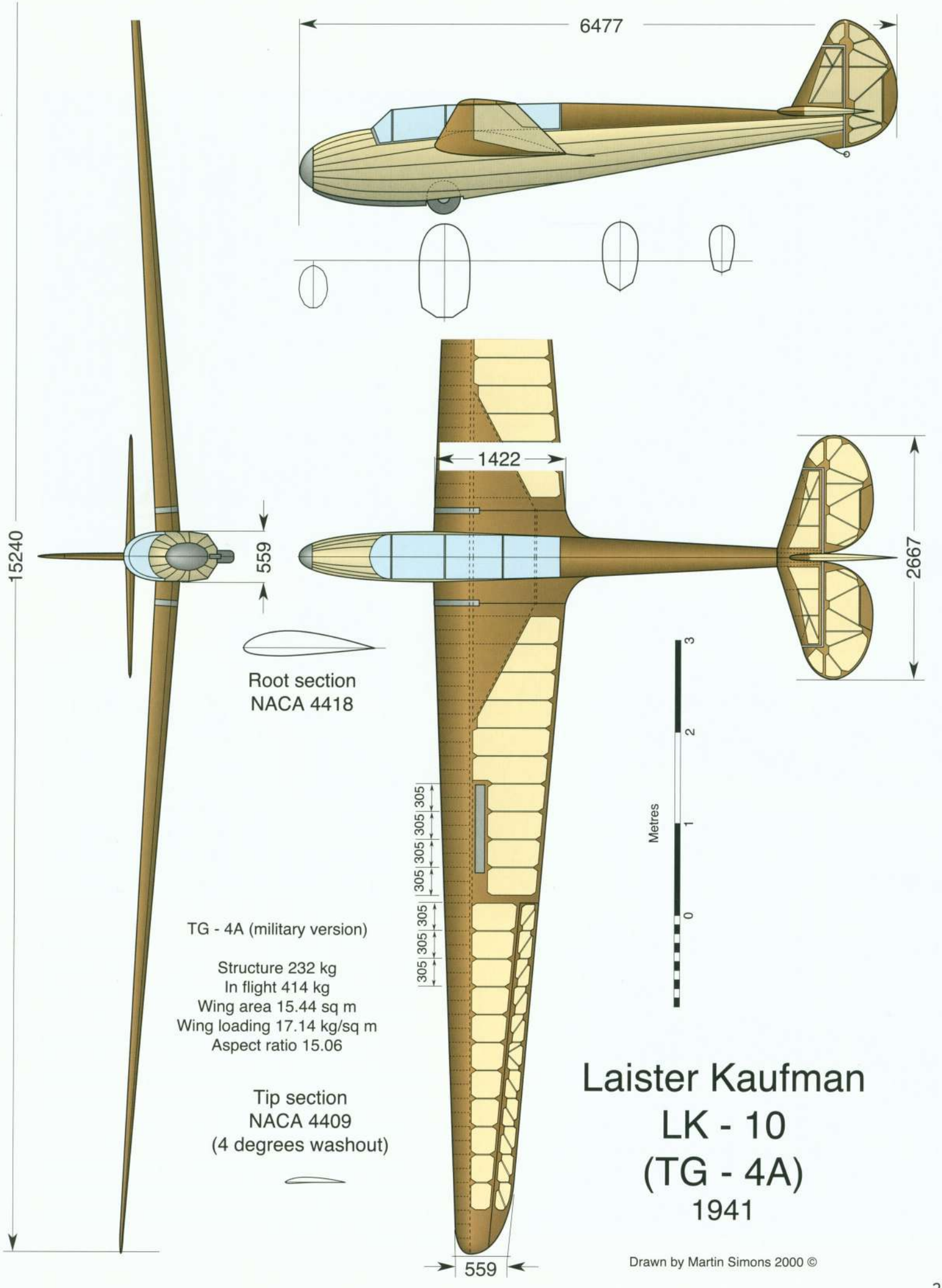
When the US Army needed two seat sailplanes for the wartime training programme, Laister offered his services and was commissioned to design a two seat version of the Yankee Doodle. This he did, calling it at first the Yankee Doodle 2. Like its single seat predecessor, it had wooden wings and steel tube fuselage, the seats in tandem with the usual vision problems for the rear pilot. The wing, with straight dihedral for simplicity of manufacture, was extended to 15.24 metres. After static and flying tests the aircraft was adopted by the army. Laister, in partnership with John Kauffmann, put the type into production in St Louis as the Laister - Kauffmann LK - 10 or, to the military, TG - 4.

Production began early in 1942 and 156 were completed. Minor improvements including a stronger wheel axle and tail skid to with-



Structure 124.7 kg
In flight 214.3 kg
Wing area 12.5 sq m
Wing loading 17.14 kg/sq m
Aspect ratio 16

Laister Lawrence Tech Yankee Doodle 1938



Laister Kaufman LK - 10 (TG - 4A) 1941

Above and left: The Laister Kauffman LK - 10, called the TG - 4 by the US military, was often modified, post war, to the so called 'flat top' configuration.

stand rough landings by trainee pilots, a moulded nose cap and turtle deck behind the cockpits, resulted in the TG - 4A.

After the war, surplus sailplanes were sold cheaply and became popular sporting sailplanes. Second and third places in the 1946 US Nationals were taken by pilots flying the LK - 10A. A very thorough study by August Raspet of Mississippi State College in 1948 revealed many ways in which the performance could be improved, including removal of the rear cockpit and decking, removal of aerodynamic control balances, fairing of the wheel and all round sealing of gaps and reduction of protuberances. The end product, called the Flat Top, was measured in flight and shown to perform rather better than the Olympia, which was, currently, the best available fifteen metre sailplane in Europe. Many national records were broken in the type. A few remain in service.

Ross Stephens RS - 1 Zanonia

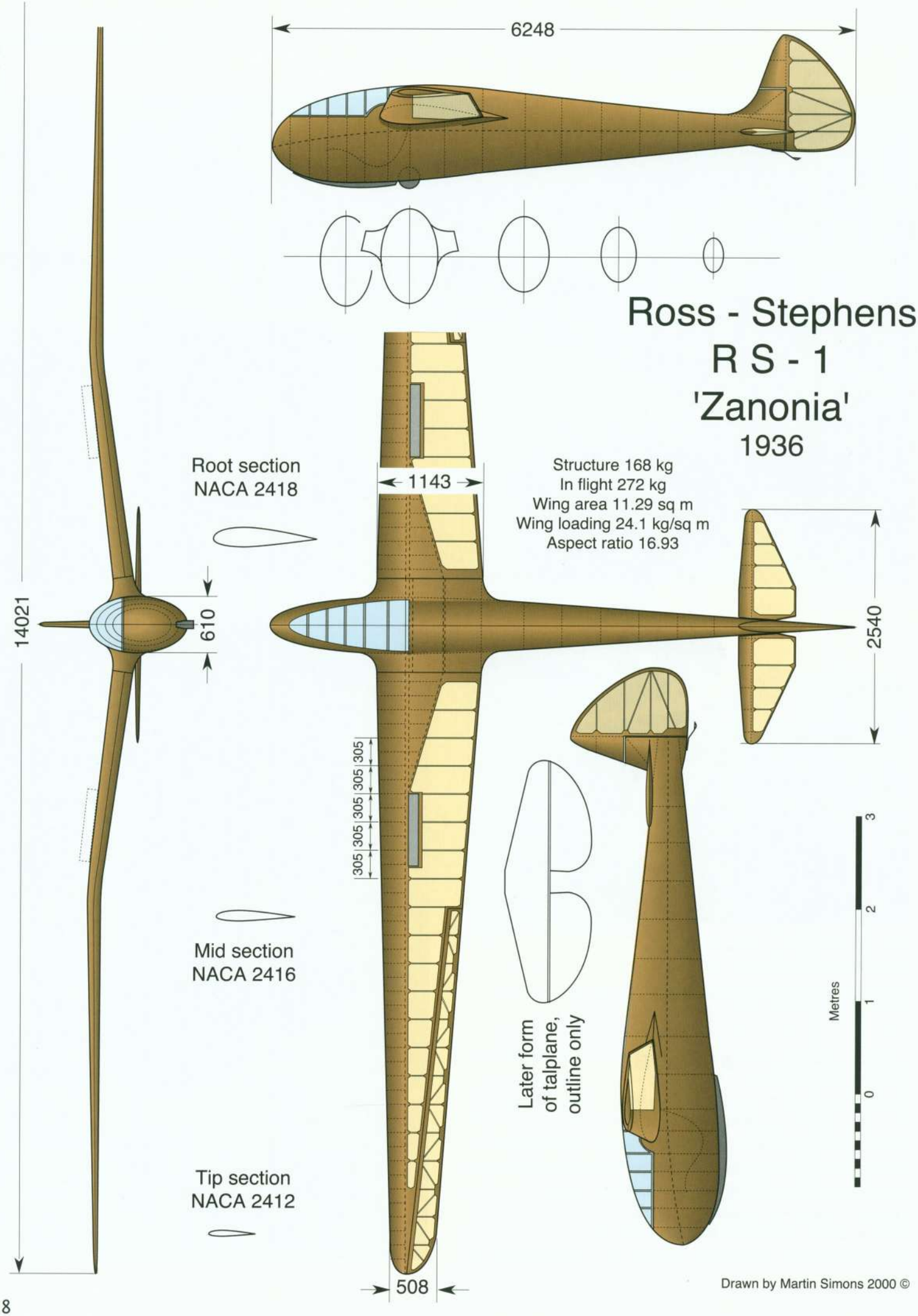
Harland Ross was an engineer commissioned in 1936 to design a high performance sailplane for the actor, Harvey Stephens. The Ross - Stephens 1 Zanonia competed in the 1937 American National Championships and did well but was badly damaged when another glider crashed into it when landing. Repairs were done but Stephens himself damaged the sailplane later in the year and further repairs were needed, including a modification to the tail unit. The all moving elevator was replaced with a conventional tailplane mounted on top of the fuselage ahead of the fin. The sailplane came into its own when bought by John Robinson, who did a great deal of work to seal, smooth and generally clean up the aircraft, improving the best glide to 29:1, extremely good for that time. He won the US Nationals three times, in 1940, '41 and '46. On New Years Day 1949 he broke Paul MacCready's world height record set the previous day, with a wave climb to 10210 metres. The following year he became the first pilot in the world to achieve all three diamonds for his Gold C badge. He sold the Zanonia in 1952. It still survives complete.

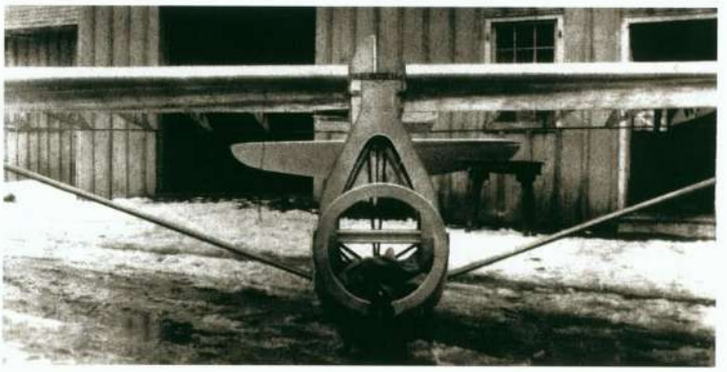
Above and left: The RS - 1 Zanonia

Right: Ernie Schweizer explains the SGU 1- 6 to a youthful admirer.

Schweizer SGU 1 - 6 Boom Tail

The Schweizer brothers, Ernie and Paul, who had graduated as engineers from the Guggenheim School of Aeronautics in New York, and their younger brother Bill, after building and flying several wooden gliders, became convinced that sailplanes should in future be built from metal. In 1936 a sailplane design competition with a worthwhile cash prize was announced, the sailplanes to be presented for test flying at the 1937 National Championships at Elmira in 'up state' New York. The brothers worked very hard to design and


6248
Ross - Stephens
R S - 1
'Zanonia'
1936
Root section
NACA 2418
1143
Structure 168 kg
In flight 272 kg
Wing area 11.29 sq m
Wing loading 24.1 kg/sq m
Aspect ratio 16.93
14021
610
2540
305
305
305
305
305
Mid section
NACA 2416
Later form
of talplane,
outline only
Tip section
NACA 2412
508
Metres
0
1
2
3
Drawn by Martin Simons 2000 ©



Left: The SGU 1- 6 flown without the cockpit canopy.

Right: The 1 - 6 under construction, showing the pressed aluminium alloy cross frames.

built their first all metal aircraft, the so called Boom Tail SGU 1 - 6. According to the numbering system they had adopted, the figure 1 indicate it was a single seater, the 6 was the number of the design, and the SGU stood for Schweizer Glider, Utility. Everything was done to ensure that the aircraft could be built with the basic equipment at their disposal. The light alloys chosen did not need heat treatment. Self tapping, plated screws were used to fasten the skins to the wing. The lack of vibration in a glider made these quite safe. Solid rivets were required only for the heavily stressed areas.

The boom tail layout was chosen for simplicity in construction, allowing the use of a plain metal tube for the boom. Open framed areas were covered with doped fabric.

As far as the brothers knew, this was the first all metal glider in the world. They were delighted when it was awarded third prize in the design competition. The first prize went to the ABC Sailplane which had a steel tube fuselage and strutted wooden wings. Second place was taken by the Harland - Ross RS - 1 Zanonia (See above).

The Schweizers made no attempt to put their Boom Tail glider into production, having become aware that it required too many hours of work to be a marketable proposition. The glider was sold to the Harvard Glider Club and used for some years before being retired.

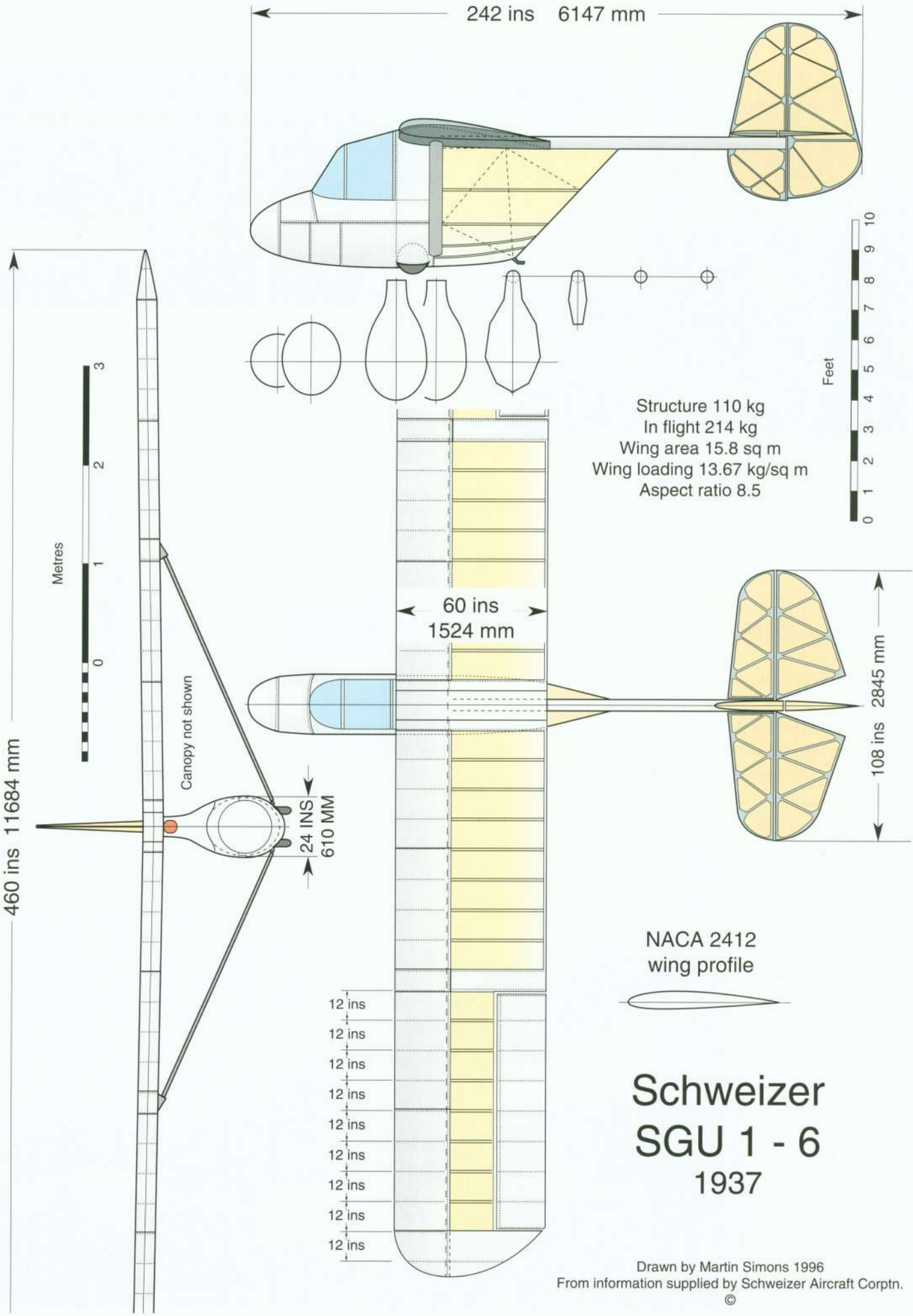
Schweizer SGU 1 - 7

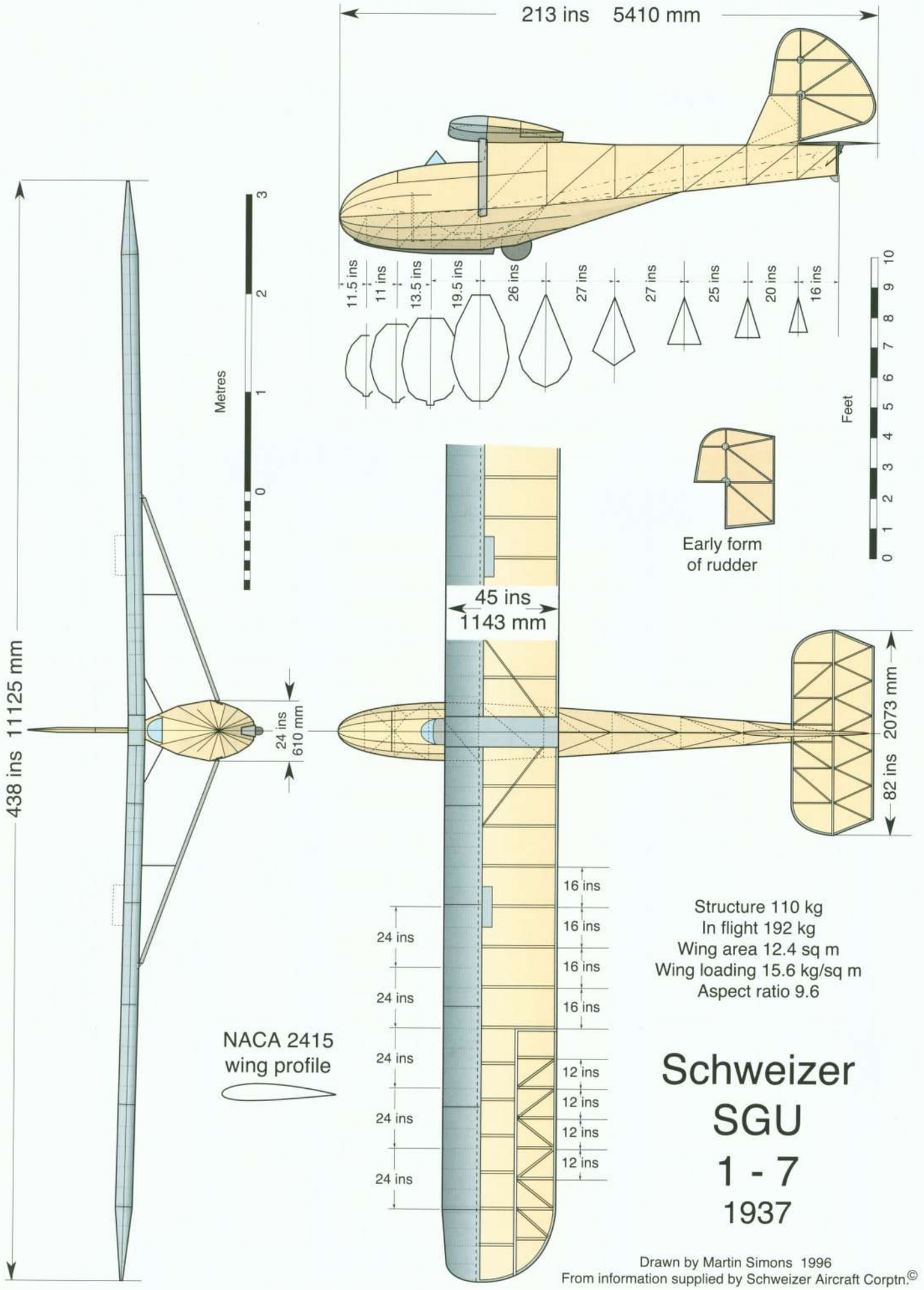
The 1 - 7 was an attempt to produce a utility glider suitable for quantity production at minimal cost. Construction was going on simultaneously with the 1 - 6 and both were presented at the design competition. The Schweizers considered that the 1 - 7 was in fact a much more practical aircraft, both in production and operation, than the 1 - 6, and thought it more deserving of the prize. The fuselage frame and the tail unit were welded up from light steel tubing and covered with fabric. The wing was from light alloys, strut braced and the open areas fabric covered. The glider was very light, flew and handled well.

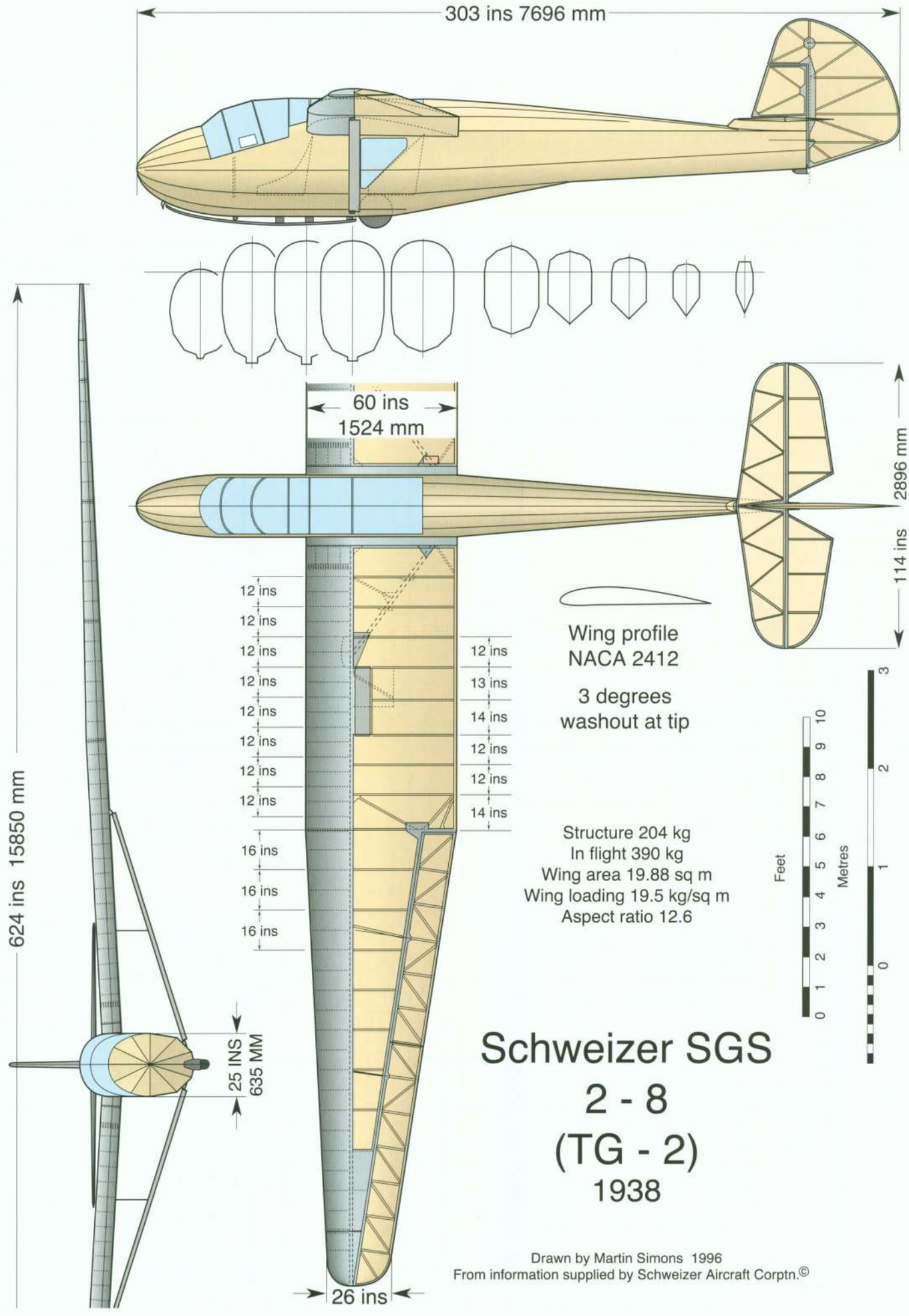
That it did not win the prize was less important than the fact that they sold the prototype and received an order for a second one, and thus entered the commercial glider production industry.

The SGU 1 - 7, years later, became the basis for a new design, somewhat larger, the SGU 1 - 19, of which 50 were built during 1944 - 6. The second 1 - 7, restored, survives and was flown again in the year 2000.

Right: The Schweizer SGU 1 - 7 had a metal wing and steel tube framed fuselage and tail, fabric covered.

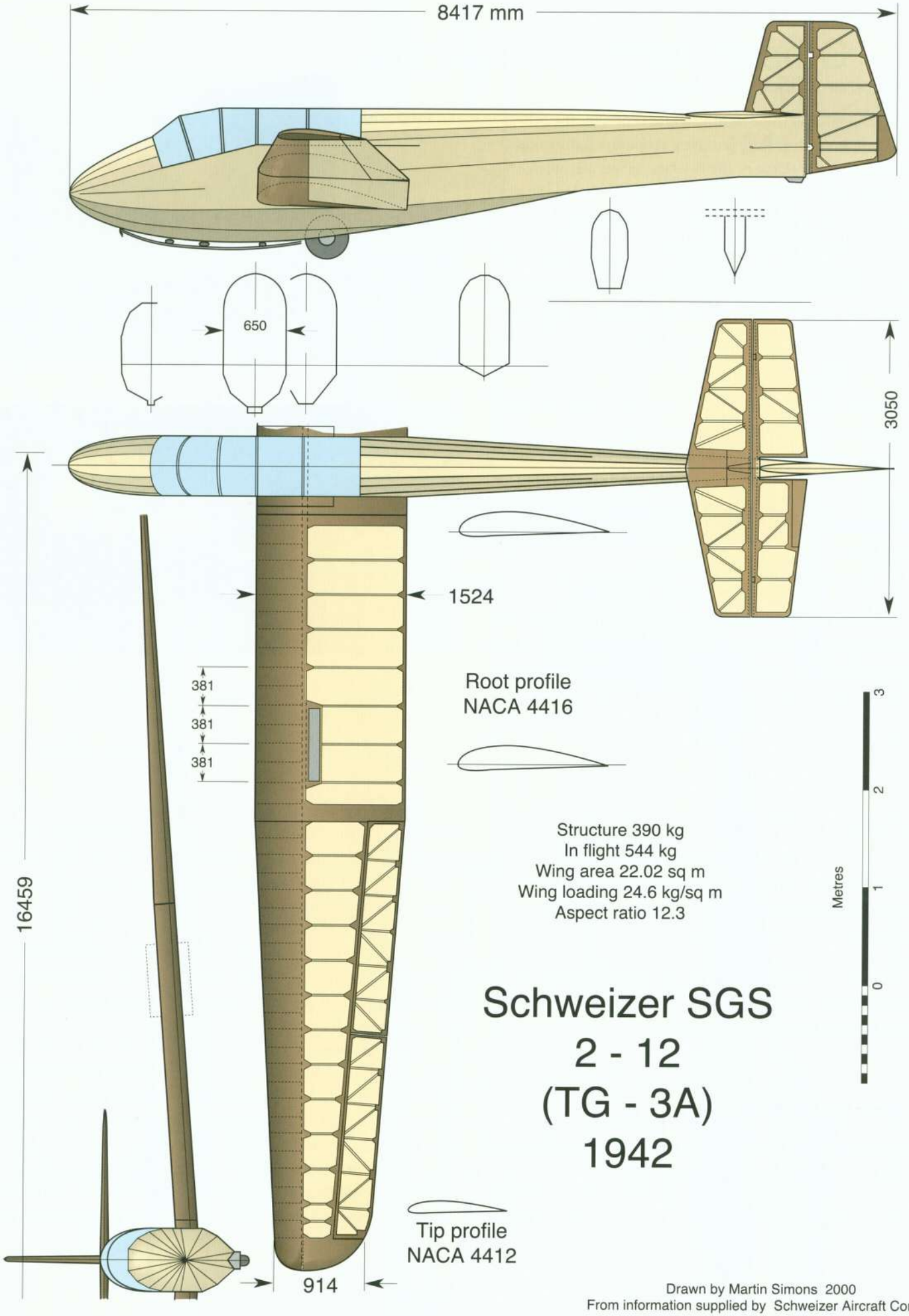

242 ins 6147 mm
Feet
0 1 2 3 4 5 6 7 8 9 10
Structure 110 kg
In flight 214 kg
Wing area 15.8 sq m
Wing loading 13.67 kg/sq m
Aspect ratio 8.5
Metres
0 1 2 3
460 ins 11684 mm
Canopy not shown
24 INS
610 MM
60 ins
1524 mm
108 ins 2845 mm
12 ins
12 ins
12 ins
12 ins
12 ins
12 ins
12 ins
12 ins
12 ins
NACA 2412
wing profile
Schweizer
SGU 1 - 6
1937
Drawn by Martin Simons 1996
From information supplied by Schweizer Aircraft Corptn.
©


213 ins 5410 mm
11.5 ins
11 ins
13.5 ins
19.5 ins
26 ins
27 ins
27 ins
25 ins
20 ins
16 ins
Metres
0
1
2
3
Feet
0 1 2 3 4 5 6 7 8 9 10
Early form of rudder
438 ins 11125 mm
24 ins 610 mm
45 ins 1143 mm
82 ins 2073 mm
16 ins
16 ins
16 ins
16 ins
24 ins
24 ins
24 ins
24 ins
24 ins
12 ins
12 ins
12 ins
12 ins
NACA 2415 wing profile
Structure 110 kg
In flight 192 kg
Wing area 12.4 sq m
Wing loading 15.6 kg/sq m
Aspect ratio 9.6
Schweizer SGU 1 - 7
1937
Drawn by Martin Simons 1996
From information supplied by Schweizer Aircraft Corptn.©



Schweizer SGS 2 - 8 (TG - 2) 1938

Drawn by Martin Simons 1996
From information supplied by Schweizer Aircraft Corptn.©



Structure 390 kg
In flight 544 kg
Wing area 22.02 sq m
Wing loading 24.6 kg/sq m
Aspect ratio 12.3

Schweizer SGS 2 - 12 (TG - 3A) 1942

Drawn by Martin Simons 2000
From information supplied by Schweizer Aircraft Corptn.

The Schweizer SGS 2 - 8 (TG - 2)

The Schweizers produced their eighth sailplane design, the SGS 2 - 8 in 1938. Apart from the fabric covering and some light wooden stringers to improve the shape of the fuselage, it was all metal. The aluminium alloy skin over the leading edge was fastened to the ribs and main spar with plated self tapping screws as with the 1 - 6 and 1 - 7. In service this proved entirely satisfactory. The fuselage was a light steel tube frame, the tail unit also, covered with fabric. The seats were in tandem. With the wing at shoulder level the rear pilot had a limited view but was aided by transparent panels in the fuselage sides below the wing. There was a landing wheel and the relatively thin wing, using the NACA 2412, 12% thick profile, was strut braced.

After the prototype was crashed in a spinning accident, the nose was lengthened to move the balance point forward. After this the 2 - 8 was very successful as a sailplane and made some very good cross country and altitude flights. The world height record climb by Lewin Barringer in 1940, 4556 metres, was not recorded by the FAI in Paris, presumably because Paris at the time had been occupied by the German army.

When the US Army began its glider pilot training programme in 1941, the SGS 2 - 8 was adopted as the TG - 2 (Training Glider - 2) and a total of 57 was reached before Schweizers were instructed to change to a wooden training glider, to conserve aluminium alloy. Still remembered mainly as the TG - 2, the military versions were offered for sale very cheaply after the end of the war and were used extensively by civilian pilots and gliding clubs. A very few of the type remain in service.

Above: Schweizer's SGS 2 - 8 was a sporting two seat sailplane, called the TG - 2 when order in quantity for the US Army.

Below: The Pratt Read G - 1, LNE 1 to the US Navy, had the seats side by side.

Schweizer 2 - 12, TG - 3

The SGS 2 - 12 was developed to meet the US Army's requirement for a two seat trainer without aluminium alloy in its structure. There were other military requirements which resulted in a somewhat heavy aircraft, but with the wing mounted low on the fuselage, the instructor in the rear cockpit had a reasonably good view. 114 of the TG - 3 were built. As with the TG - 2, those remaining at the end of hostilities were sold cheaply. Stripped of their military equipment they proved useful to gliding clubs.

Pratt Read G - 1, LNE - 1 or TG - 32

The G - 1 was originally a civilian design but, making its appearance early in the Second World War it became absorbed into the military glider pilot training programme. From the official viewpoint it had the advantage of not requiring any scarce resources. The wing plan form resembled that of the famous Grunau Baby, but the aerofoil sections were from the Sikorsky series, GS - 4 at the root, GS - M at the inner end of the ailerons and GS -1 at the tip. The two seats were side by side, enclosed within a large steel framed, fabric covered nacelle, with capacious transparent canopy. The wing, slightly swept back to improve balance after early test flights, was of orthodox wooden construction. The tail was carried on a circular sectioned plywood boom. In the training role the performance was quite adequate and the G - 1 was adopted by the US Navy as the LNE - 1. A few were also taken by the Army as the TG - 32.

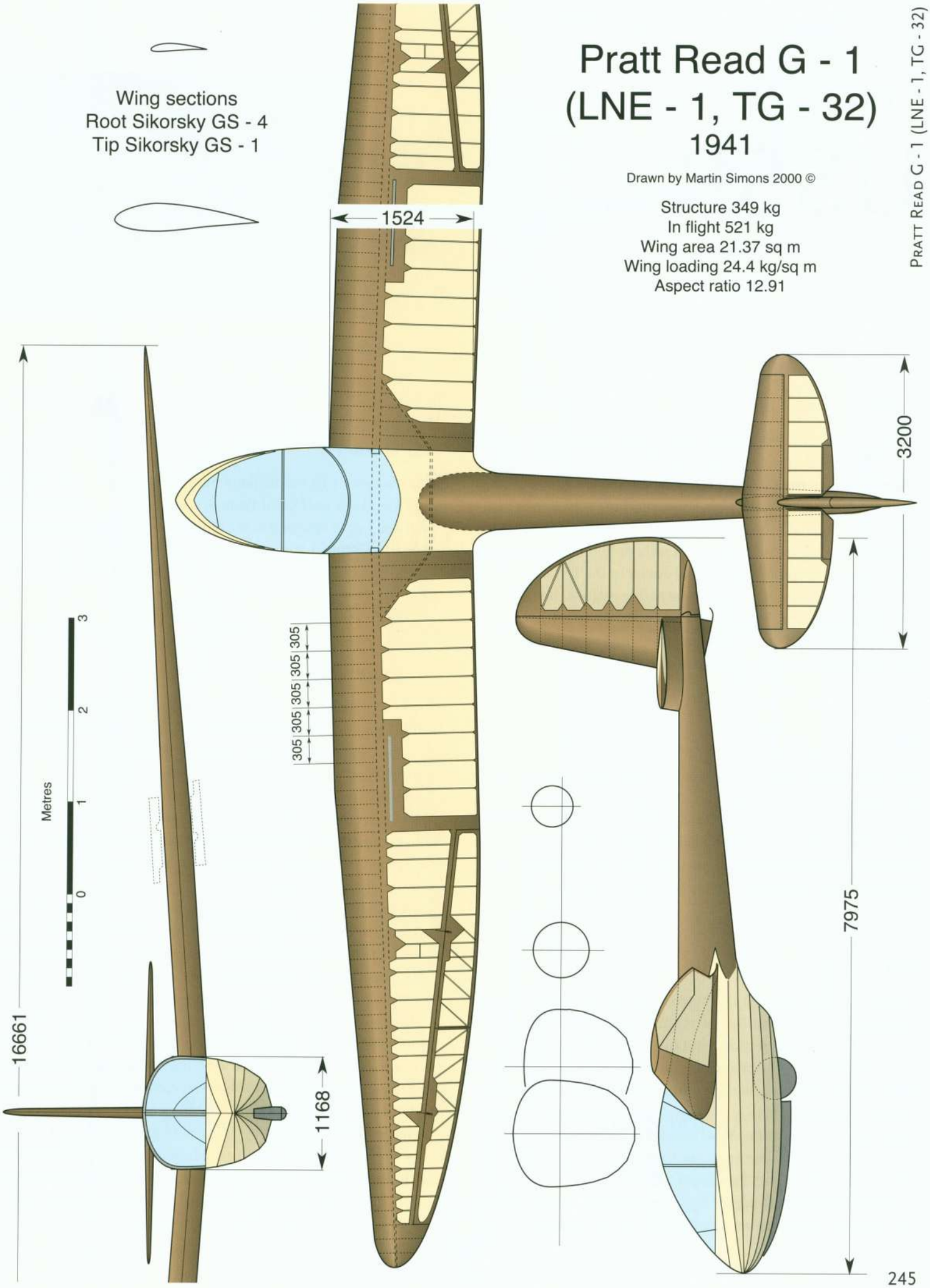
A total of 75 were built. Like other military two seaters, they were sold cheaply after the war. Most notably, two were used in the scientific research work on standing waves in the lee of the Californian Sierra Nevada. The world height record was broken by Larry Edgar and Howard Klieforth in March 1952, 13849 metres, during these studies. In April 1955 one of the Pratt Reads, flown by Edgar, was destroyed at 4500 metres altitude in severe turbulence in the rotor of a wave. Edgar was thrown clear and was able to use his parachute.

Pratt Read G - 1 (LNE - 1, TG - 32)

1941

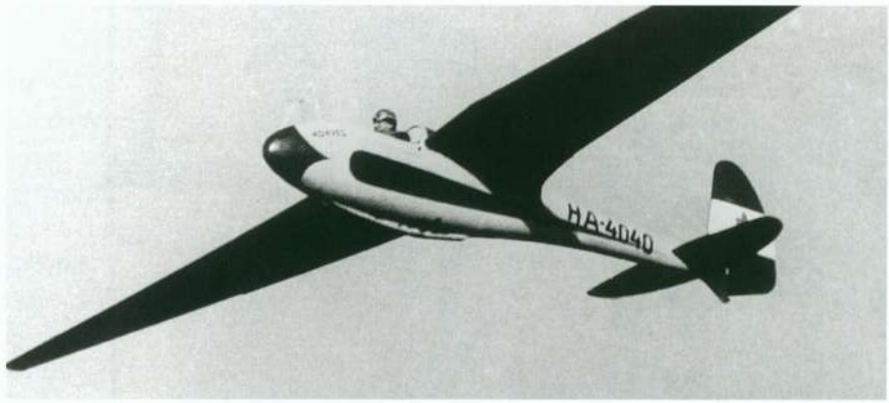
Structure 349 kg
In flight 521 kg
Wing area 21.37 sq m
Wing loading 24.4 kg/sq m
Aspect ratio 12.91

Wing sections
Root Sikorsky GS - 4
Tip Sikorsky GS - 1



CHAPTER 24

USSR



Photographs of Russian sailplanes are rare. This GN - 7, HA - 4040 flew in Hungary.

Since the Soviet pilots' visit to the Wasserkuppe in 1925 and the reciprocal visit of the Germans to the soaring site in the Crimea, gliding in the Soviet Union attracted government support. In the west, almost nothing was learned of developments there until Soviet pilots began to break world records in the late thirties. Only gradually was it realised that there had been a very diverse programme of sailplane design in the USSR since that time. Scores of different designs, some highly original, had been developed. It is still almost impossible to obtain detailed information or photographs of any of these aircraft. Some very sketchy three view drawings and a few leading statistics exist.

PS - 2

The same needs arose for intermediate sailplanes in the USSR as elsewhere and, in the mid thirties, O. A. Antonov produced the PS - 2 which, like the Salamandra, was developed from a primary glider but with a much improved wing and nacelle for the pilot. Antonov produced a booklet showing how this sailplane could be built by amateurs. How many were actually flown is not known.

GN - 7

The GN - 7 was designed by the engineer Groshev, a 16.8 metre sailplane based on an earlier, successful design. The most unusual feature was the centre section, built integrally with the fuselage at a steep dihedral angle, so that when the wings were joined to it the effect was a gull form without the usual trouble of building a curved main spar. There was some quantity production but how many were flown is not known. The GN - 7 became particularly famous because it was used by Victor Rastorguyev to break the world distance record with a 652 km flight in 1937.

One was taken to Hungary during the second World War and flew there for some time until written off in a bad landing.

Rot Front 7

Rastorguyev's record distance stood for a year until broken by Olga Klepikova in the Rot Front 7, with 749 km. This stood until 1939 and was of course also the feminine world record. Apart from the basic outline, hardly any details are known about Klepikova's aircraft except that it had a span of 16.3 metres and aspect ratio of 22.5. The designer was O.K. Antonov.

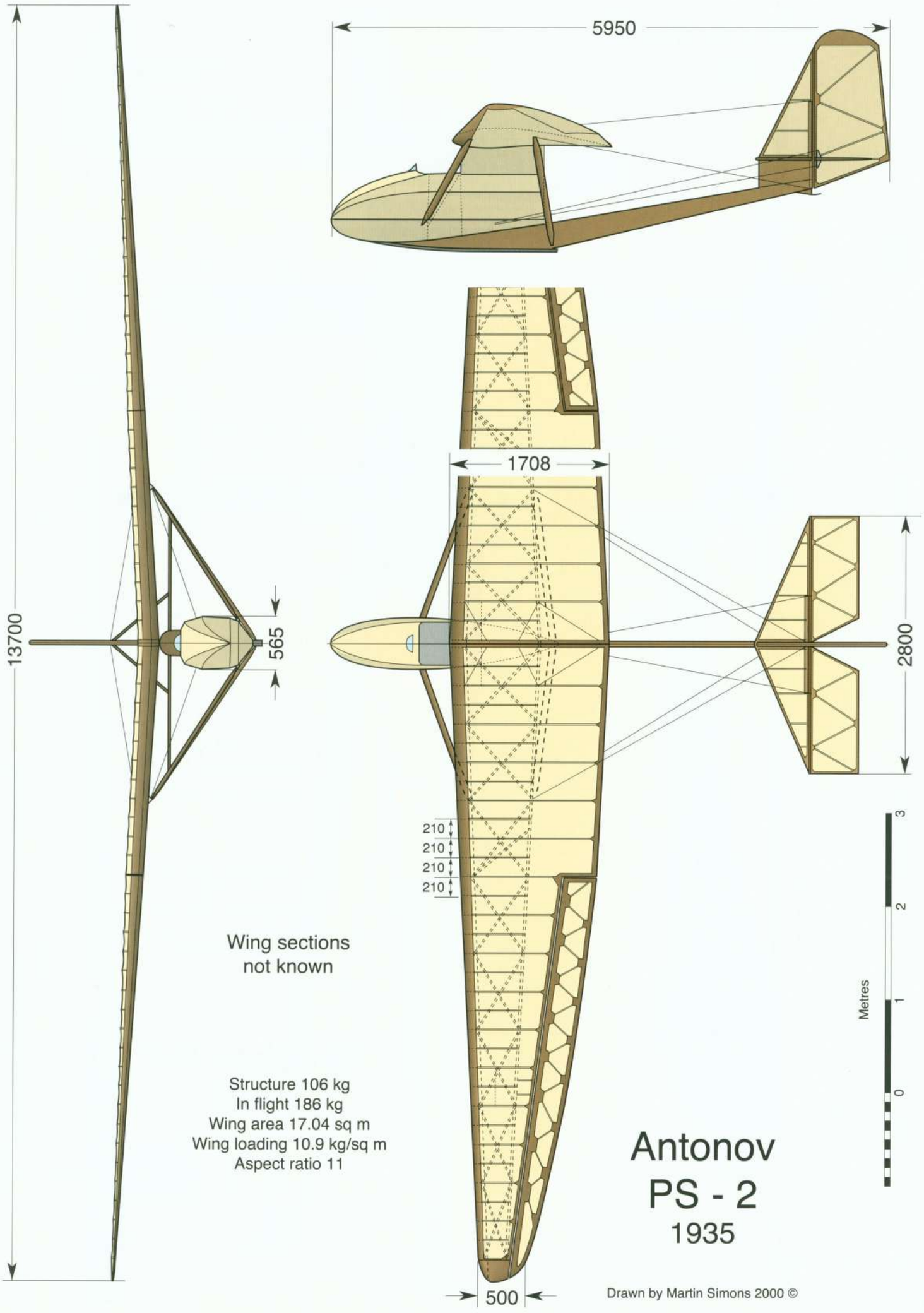
Stakhanovetz

A. G. Stakhanov was a miner who, in the USSR, was made a hero in 1935 for his great output of coal. In 1936 at the Paris Air Show, a large two seat sailplane, the Stakhanovetz, named in his honour, was exhibited.

The problem of visibility from the rear seat of a tandem sailplane was solved by the strongly swept forward wing. This ensured that the rear seat could be placed close to the centre of gravity and yet the second pilot had an excellent view in all directions. The sweep forward also helped to prevent wing tip stalling and spinning, reducing the need for wing twist or 'washout' and enabling the sailplane to fly fast without the outer wing being forced to a negative angle of attack and so 'lifting' downwards. The same layout has been used on many two seat sailplanes since 1936. In other respects the Stakhanovetz was of orthodox wooden construction.

Designed by V. Emilyanov, the aircraft was extremely efficient. Assuming it handled reasonably well, in its day it must have been the best two seat sailplane in the world. This is supported by its breaking and re-breaking international two seat cross country flying records. In 1938 pilots Kartachev and Savtov flew 619 km distance, in 1939 Kartachev and Gorokhova made a goal flight 0f 393.7 km and a year later Kartachev with Petretschenkova, 495 km. Female records also fell to this sailplane, Olga Klepikova with Bordina flew a distance of 443.7 km in 1940, and a goal flight of 223.6 km was made in 1939

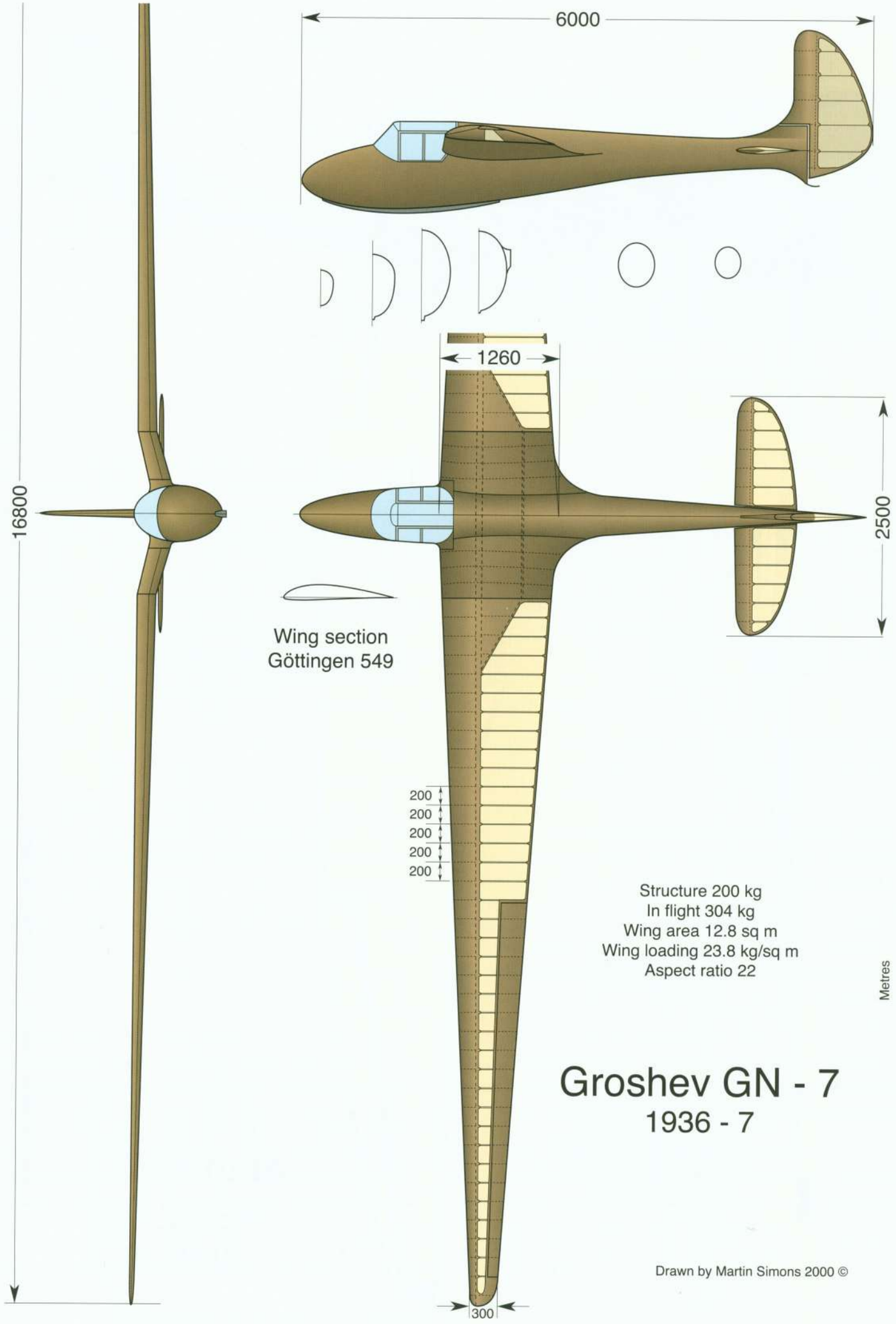
How many of the type were built is not known.



Wing sections
not known

Structure 106 kg
In flight 186 kg
Wing area 17.04 sq m
Wing loading 10.9 kg/sq m
Aspect ratio 11

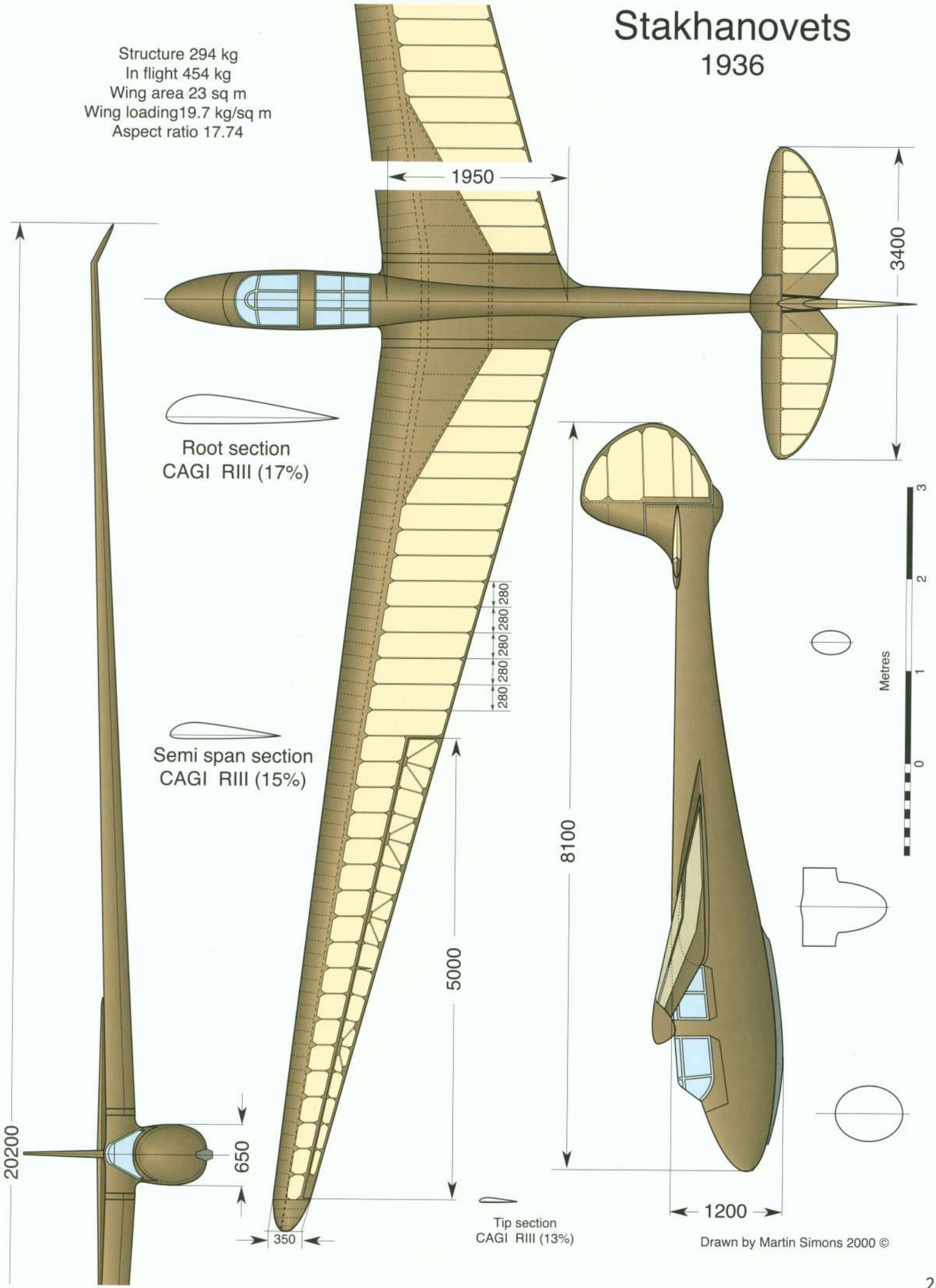
Antonov
PS - 2
1935



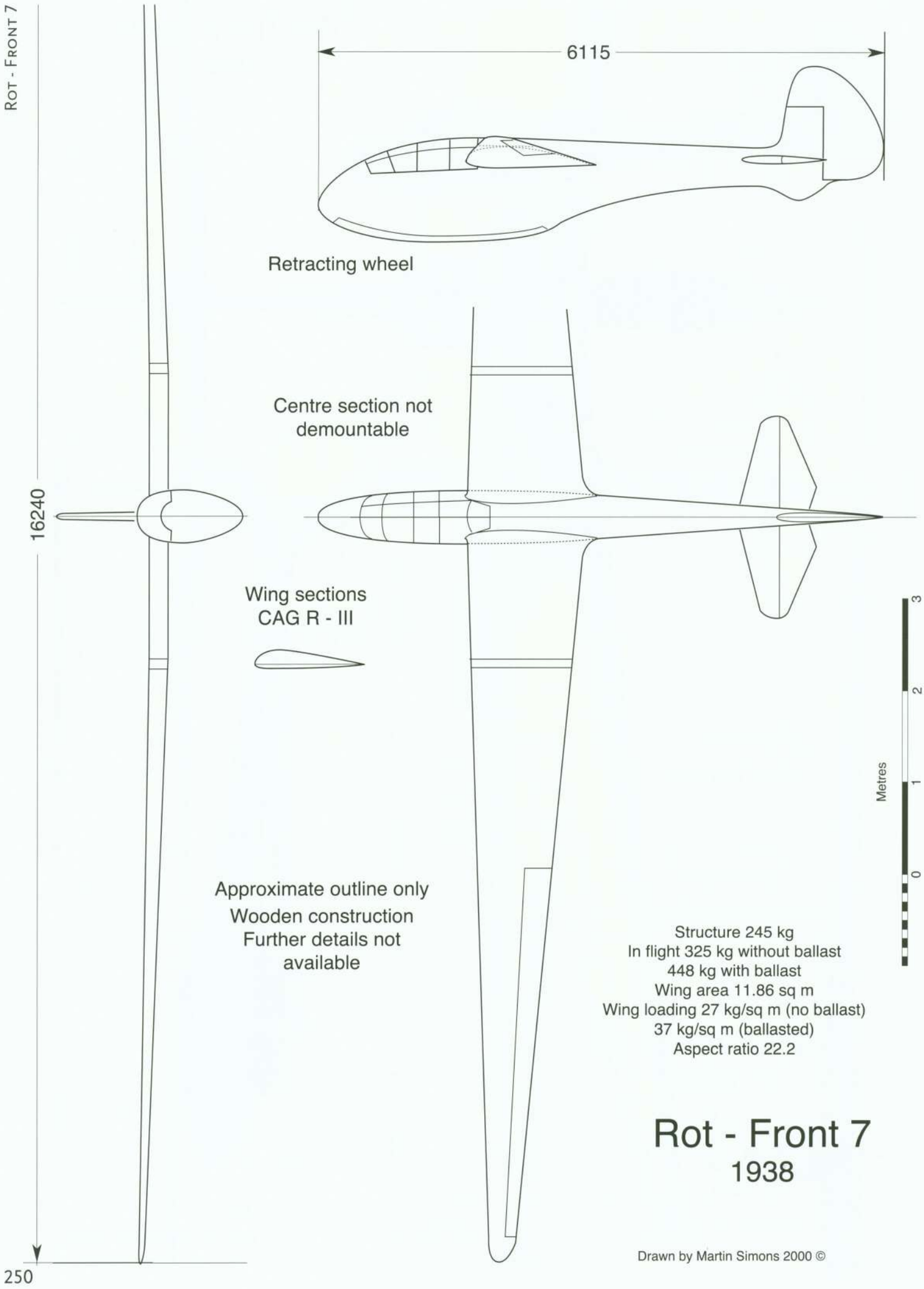
Groshev GN - 7
1936 - 7

Stakhanovets
1936

Structure 294 kg
In flight 454 kg
Wing area 23 sq m
Wing loading19.7 kg/sq m
Aspect ratio 17.74



Drawn by Martin Simons 2000 ©


ROT - FRONT 7
6115
Retracting wheel
Centre section not demountable
16240
Wing sections
CAG R - III
Approximate outline only
Wooden construction
Further details not available
250
Metres
0
1
2
3
Structure 245 kg
In flight 325 kg without ballast
448 kg with ballast
Wing area 11.86 sq m
Wing loading 27 kg/sq m (no ballast)
37 kg/sq m (ballasted)
Aspect ratio 22.2
Rot - Front 7
1938
Drawn by Martin Simons 2000 ©

APPENDICES

About the drawings

The drawings in this work were all done by the author using Adobe Illustrator Version 8 on various Apple Macintosh Computers.

Some of the small general arrangement drawings published in contemporary magazines and even those issued by manufacturers in brochures, etc, on close examination prove to be inaccurate and even self contradictory. Wherever possible, in preparing the drawings for this book, original workshop plans, actual measurements and photographs have been used to produce the best possible result.

No attempt has been made to show items of equipment such as instruments, externally mounted pitot tubes, venturis, etc., because in practice these were often moved to different locations or changed from season to season. Also, as photographs show, there were a great many variations to items such as cockpit canopies, windscreens, skids and other small items. Model makers and others who are anxious to establish exact details, have no recourse other than careful study and measurements of an actual aircraft.

Colours and markings

Until the nineteen thirties it was almost unknown for a sailplane to be painted. It was thought vitally important to save every fraction of weight. A pigmented paint would add several kilogrammes, increase the rate of sink and make soaring more difficult.

The normal treatment was to brush into all the fabric covered surfaces several coats of clear cellulose dope. This sealed the pores to make the covering airtigtht, at the same time shrinking the cloth to the tautness of a drum. The material used was fine quality cotton, 'madapolam', which was perfectly white, or unbleached linen of a light buff hue. The cloth had approximately the feel and weight of a good summer shirt. Exceptions were the French Peyret Tandem, covered in rubberised fabric, and in a very few cases, pure silk, which did not prove satisfactory.

Sewing the fabric to the ribs was not usually necessary except with strongly undercambered wings. The covering was glued on, often with un-thinned dope.

The shrinking fabric tended to distort the lighter parts of the framework, such as the trailing edges of wings and tails, so it was common to find these members warping to some extent after a few weeks in use. Wing ribs were often braced against sideways distortion with light secondary spars or lengths of cotton tape woven laterally, zig zag fashion between the ribs internally.

Plywood skins were also doped to prepare the surfaces for the final treatment, several coats of high quality marine varnish over fabric areas as well as the plywood. The end result was a very high gloss over the entire external surface.

In all cases, the varnish changed colour and darkened greatly, especially after a season or two in the sun.

It was very common for manuafacturers, clubs and sailplane owners to add 'logos', names, national or regional emblems, cartoons and even advertisements, to their sailplanes, simply painting these onto the surface before or after the final coat of varnish. These could be changed easily, and often were. A few sailplanes, such as the Schloss Mainberg, had highly elaborate and detailed paintings on the rudder or elsewhere. In competitions, numbers could be added by painting with distemper, removed after the contest, or by sticking on sheets of paper carrying the figures, also removed later. It was therefore very common for a sailplane to be altered in appearance from one week to the next. Any repairs or modifications would also cause alterations. For instance, a new plywood panel would have a markedly lighter colour than the older skin. The same with fabric patches.

Formal registration letters and numbers were not always required for sailplanes. In Britain, for example, the only identifying marks might be a small BGA number on the fuselage under the tailplane, sometimes not even this. In other countries the registration might be required, but always with local variations according to the whims of the owners.

In the early nineteen thirties, when it was realised that a little extra weight did not matter very much, or could even be an advantage, painting sailplanes become more common. Unpainted fabric would perish after a very few seasons exposure to the sun. Complete re-covering was expensive and time consuming so it became normal to use a pigmented dope, red or aluminium, to provide a basis for the paint.

In Germany, at various times after 1933, officially approved colour schemes were laid down, together with registration numbers and letters related to the various regional divisions of the country (including Austria after the Anschluss of 1938). However, the official requirements were not always met, especially with older aircraft which were not repainted immediately, or ever, when the official decrees were issued. The rules in any case were changed from time to time, and gliders belonging to the Luftwaffe had their own registration system, different from the NSFK and the remaining privately owned sailplanes. As always, the only way to establish with certainty what colour scheme and markings are appropriate for a restoration project or a model, is to study photographs of the particular sailplane.

In other countries the same applies, only more.

Acknowledgements

This book owes much to the following sailplane designers, constructors and pilots. Some are now deceased. The author thanks them for their assistance in correspondence and conversations, and for their kindness in supplying photographs, drawings and correcting errors.

L.E. Baynes, Waclaw Czerwinski, Klaus Heyn, Harold Holdsworth, Walter Horten, August Hug, Hans Jacobs, Richard Johnson, Jack Laister, Reiner Karch, Alexander Lippisch, Geoff Richardson, Peter Riedel, John Robinson, Lajos Rotter, Hans Sander, Martin Schempp, Harry Schneider, Willi Schwarzenbach, Paul, Ernie and Bill Schweizer, Fred Slingsby, Jacob Spalinger, John Sproule, Geoffrey Stephenson, Chris and Philip Wills.

A great many other people have helped by supplying photographs, drawings and advice. Those not already mentioned are listed below:

Allan Ash, Ray Ash, Geoff Bailey Woods, Ted Baker, Mike Beach, Otto Bellinger, Richard Benbough, Raul Blacksten (VSA), A.J.R. Brink, R. Buettner, George Burton (Vickers Slingsby Ltd), Hollis Button, Jeff Byard, Ary Ceelen, Dave Craddock, Jerzy Cynk, Louis de Lange, Martin Deskau, Hans Disma, James Ealy, Norman Ellison, Georgio Evangelisti, Helen Evans (S & G), Berndt Ewald (Tech Hochschule Darmstadt) Jochen Ewald (Akaflieg Aachen), Flight International staff, Hans Folgmann, Nathan J. Frank, Thorsten Fridlizius, Mike Garnett, Paul Gibson, Andrjé Glass, Nick Goodhart, James Grantham, Jim Gray, F R Hamilton, Bertrand A Handwork, Arthur Hardinge, Theo Heimgartner, Ted Hull, F. Mitter Imre, Brigitte Keane, Max Kroger, Doug Lamont, Peter Layne, Mita Levin, Forester Lindsley, Paul MacCready, Dean R. McMillian, Tony Maufe, J.R.C. (Rodi) Morgan, Richard K. Ng, George Nuse, Alan, Ian and Tighe Patching, Vincenzo Pedrielli, Marici Phillips, Theo Rack (Wasserkuppe Museum), Christian Ravel, Roger Reffell, Chris Riddell, Mike Russell, Michael Rutter (Slingsby Aviation Ltd), Gunter Schapka, Paul Serries, Eva and Willy Simo, Simine Short, Patricia Simons, Alan E. Slater, Louis Slater, Shirley Sliwa, Bob Slusarev, Tom Smith, Geoff Steele, Bob Storck, Gary Sunderland, Marton Szigeti, George Thompson, Knut Uller, Niels Visser, Wolfgang Wagner, Doc Walker, Ernst Walter, Per Weishaupt, Reiner Willecke, Paul Williams, Hans Zacher and Walter Zuerl.

Among the public institutions whose services have been gratefully employed are the British Library, The State Library of South Australia, the libraries of Cambridge, London and Adelaide Universities, the USSR National Public Library for Science and Technology and The Lenin State Library, Moscow (as they were), the Technical Information Service of the American Institute of Aeronautics and Astronautics, the Archives of the Verkehrshaus Swiss Transport Museum, Lucerne, the Wasserkuppe Museum and the National Soaring Museum, Elmira. Help has also been given by the Vintage Glider Club, the Vintage Soaring Association of the USA and Vintage Gliders of Australia.

The Author

The author, Martin Simons, born in 1930, has been involved in gliding for more than fifty years. With the Gold C badge and two diamonds, he has flown about one hundred different types of sailplane, including twenty of those described in this work. He is also a keen model sailplane designer, builder and flier.

English by birth, he is now based in Adelaide, South Australia, with dual citizenship. His previous books include Slingsby Sailplanes, a standard reference work on the famous British glider manufacturing company, and he collaborated with Paul Schweizer to produce Sailplanes by Schweizer, a companion book about the leading American manufacturer. His book, The World's Vintage Sailplanes 1908 - 45, was published in 1986. He also wrote Model Aircraft Aerodynamics, the only work of its kind in English, and a great many shorter articles and books, some not actually about aviation!

BIBLIOGRAPHY

Books and monographs

Akaflieg München, 50 Jahre Akaflieg München (Zuerl).

Andrews, J P, Gliding and Soaring (McBride, New York, 1944).

Antonov, O K, Texnicheskoe Opisante Planerov, YS-3 & PS-1 (Moscow, 1933).

Antonov, O K & Shashaorin, A, Texnicheskoe Opisante i Akspluatadivah Planerov YC-4 & PS-2 (Moscow, 1936).

Apostolo, G, Centro Studi ed Esperienze per il Volo a Vela (Politecnico di Milano 1998).

Army Air Forces, Air Service Command, Technical Orders, Pilot's Operating Instructions, Erection and Maintenance Instructions, Parts Catalogue, for TG-3 and TG-4 gliders, Tech Order Numbers 09-15-AA-1 to 4 and 09-30 AB-1 to 4 (January to March 1943).

Ashwell Cooke, J R, (Ed), Motorless Flight (John Hamilton, London, 1932).

Barnaby, R S, Gliders and Gliding (Ronald Press Co, New York, 1930).

Barnaby, R S, A History of American Soaring (American Soaring Handbook, Vol 1, Soaring Society of America, 1963).

Barringer, Lewin B, Flight Without Power (Pitman, New York, 1940).

Bohdan, Aret, Poles Against the V Weapons (Interpress, Warsaw, 1972).

Brütting, G, Segefflug Erobert die Welt (Knorr & Hirth, München Ulm, 1952).

Brütting, G, Die Berühmtesten Segelflugzeuge (Motorbuch, Stuttgart 1970).

Brütting, G, Die Geschichle des Segelflugzeuges (Motorbuch, Stuttgart 1972).

Brown, E, Wings of the Weird and Wonderful Vol 1 (Airlife, 1983)

Butler, P H, British Gliders (Merseyside Aviation Society, Liverpool, Ist edition, 1970, 2nd edition, 1975).

Castello, C, Castel Mauboussin Planeurs et Avions.

Coates, A M, Jane's World Sailplanes (Macdonald & Janes, London, 1978).

Coggi, I, Fabrizio, J, Mantelli, A, Bignozzi, G, SAI Ambrosini CVV 6 (Monografie Aeronautiche Italiane, 1982).

Csandi, N, Nagyvaradi, S, Winkler, L, A Magyar Repules Toertenete (Müszaki Könyvkiadó, Budapest, 1977).

Cummings, M M, The Powerless Ones (Frederick Muller, London, 1966).

Cynk, J B, Polish Aircraft 1893 - 1939 (Putnam, London, 1971).

Czerwenka, Dr, 50 Jahre Akademische Fliegergrappe Braunschweig 1922-1972 (Akaflieg Braunschweig, 1972).

Douglas, A C, (Welch, A,) Gliding and Advanced Soaring (John Murray, London, 1947).

Edmonds, A C, (Welch, A,) Silent Flight (Country Life London, 1937).

Ellison, N, British Gliders and Sailplanes 1922-1970 (A & C Black, London, 1971).

Eyb, R, Fliegerhandbuch (Richard Carl Schmidt, Berlin, 1926).

Frati, S, L'aliante (1946 reprinted Libraria Gatti Editrice, 1991).

Gabor, J, Magyar vitorlázó Repülögépek (Müszaki Könyvkiadó, Budapest 1988).

Galé, F, Tailless Tale (B2 Streamlines, Olalla, Washington State, USA)

Gibbs - Smith, C H, The Aeroplane (HMSO, London, 1960).

Gibbs - Smith, C H, The Invention of the Aeroplane (Faber and Faber, London, 1966).

Glass, A, Polske Konstrukcie Lotnice 1893-1939 (Wydawnietwa Komunikacjii Lacznosci, Warsaw, 1976).

Goodyear, H R R, (Ed), Gliding Yearbook 1931 (Dorset Gliding Club, Weymouth, 1931).

Groesbeek, W J & Osinga, N, Voor den Oorlog (Self published).

Gymnich, A, Der Gleit und Segelflugzeugbau (Richard Carl Schmidt, Berlin, 1925).

Haanen, K T, Robert Kronfeld (Walter Zuerl, Munich, 1962).

Hakenjos, R, & Goebel, H, Der Weg zum Klippeneck (Sportfliegergruppe Schweningen, 1977).

Heidler, K, FVA, (Flugwissenschaftliche Vereinigung Aachen 1980).

Heiss, L, Hirth, Vater, Helmuth, Wolf (R A Muller, Stuttgart, 1949).

Hirth, W, Die Hohe Schule des Segelfluges (Stuttgarter Vercinsbuchdruche, Stuttgart, 1938, translated as The Art of Soaring Flight by Naomi Heron Maxwell).

Hirth, W, Handbuch des Segelfliegens (Frank'sche, Stuttgart, 1938).

Hirth, W, Gmbh, Betriebshandbuch Kunst Segelflugzeug Habicht (Nabern Teck, 1942).

Hoinville, F, Halfway to Heaven (Angus and Robertson, Sydney, 1961).

Horsley, T, Soaring Flight (Eyre and Spottiswoode, London, 1944).

Howard Flanders, L, and Carr, C F, Gliding and Motorless Flight (Pitman, London, 1932).

Humen, Wlodzimierz, Soaring in Poland (Polonia, Warsaw, 1957).

Ilchenko, V, Parahschtchie Polet (DOSAAF, Moscow, 1964).

Imré, Mitter, A Magyar Vitorlázórepülés Képes Története 1929 - 1999 (Mitter, 1999).

Jacobs, H, Werkstattspraxis fur den bau von Gleit und Segelflugzeuge (Otto Maier, Ravensburg, 1930?).

Jacobs, H, Leistungs Segelflugmodell, Spiel & Arbeit 115 (Otto Maier, Ravensburg 1930?).

Jacobs, H, Schwanzlose Segelflugmodelle, Spiel & Arbeit 114 (Otto Maier, Ravensburg 1930?).

Jabrov, A A, Kak i Pochemu Letaet Planer (Moscow, 1938).

Kawakami, H, Nihon no Glider 1930 - 1945 (Japanese Gliders 1930 - 1945) (1998)

Kens, K, Flugzeugtypen 1953 (Carl O Lange, Duisberg, 1953).,

Krasilschkov, A P, Planersi SSSR (Mashinostroi, Moscow 1991).

Kronfeld, R, Kronfeld on Gliding and Soaring (John Hamilton, London, 1932).

Langsdorff, W von, Das Segelflug (J F Lehmanns, Münich, 1923).

Latimer-Needham, C H, Sailplanes, their design, construction and pilotage (Chapman and Hall, London, 1932).

Lilienthal, Gustav, Vom Gleitflug zum Segelflug (Volckman, Berlin, 1923).

Lippisch, A, The Delta Wing (Iowa State University, 1981).

Maresch, G, Erwin Musger Flugzeug- and Fahrzeugkonstrukteur (Blätter für Technikgeschichte 48 Heft, Wien, 1986).

Mason, H Molloy, The Rise of the Luftwaffe (Cassell, London, 1975).

Mazzaron, A G F Il Volo a Vela Italiano (Tecna, 1991).

Miller, R, Soaring 1965 Yearbook (Soaring International, San Francisco, 1965).

Miller, Richard, Without Visible Means of Support (Miller, Los Angeles, 1967).

Modellsport Verlag, Flugzeugtypen (Segelflugzeuge). Band 1, Band 2 (Modellsport Verlag 1998, 9).

Mrazeck, James E, Fighting Gliders of World War 2 (R Hale, London, 1977).

National Advisory Council for Aeronautics,Technical Memoranda numbers 59, 100, 140, 166, 181, 186, 265, 433, 434, 471, 514, 560, 623, 637, 666, 762, 780

Nickel, K & Wohlfahrt, M, Trs Brown, E, M, Tailless Aircraft (AIAA 1994).

Nimführ, Raimund, Mechanische and Technische Grundlagen des Segelfluges (Richard Carl Schmidt, Berlin, 1919).

Organisation Scientifique et Technical de Vol a Voile, The World's Sailplanes, Volume 1, 1958, Volume 2, 1963.

Organisation Scientifique et Technical de Vol a Voile, Publication VI, 1960.

Pagé, V W, Henley's A B C of Gliding and Sailflying (Chapman and Hall, 1930).

Peter, Ernst, Segelflugstart (Motorbuch Verlag Stuttgart, 1981).

Pilcher, Percy S, Gliding (Aeronautical Classics Number 5, Aeronautical Society of Great Britain, 1910).

Raunio, Jukka, PIK-Sarjan Lentokoneet (Forssan Kirjapaino Oy, Forssa 1995).

Ravel, C, Histoire des Planeurs SA 103, 104 Émouchet (Le Musee de l'air et de l'espace 1996).

Reitsch, H, The Sky my Kingdom (Bodley Head, London, 1955, translated by Lawrence Wilson from Fliegen mein Leben).

Riedel, P, Start in den Wind (Motorbuch, Stuttgart, 1977).

Riedel, P, Vom Hangwind zur Thermik (Motorbuch, Stuttgart, 1984).

Riedel, P, Über Sonnige Weiten (Motorbuch, Stuttgart, 1985).

Riegels, F W, Aerofoil Sections (Butterworth, London, 1961, translated by D G Randall).

Ross, M, Sailing the Skies (Macmillan, New York, 1931).

Rovesti, P, Ali Silenziose del Mondo (Dalla Rivista 'Volo a Vela', 1975).

Royal Aeronautical Society, Handbook for Aeronautics Vol 1 (Pitman, London, 1961).

Rozanov, A M, Stoklitskia, C L, Antonov, O KTecnika i Practika Planerisma (Moscow, 1934).

Rutschi, H, Segelflug (Switzerland, 1944).

Sato, H, (Ed Kimura, H) Nihon Glider Shi (History of Japanese Gliding) (ISBN 4 87415 272 4)

Schneider, E, Flugzeugbau Schneider Catalogues 1931, 2

Schneider, H, Flugzeugtypenbuch 1944 (H Beyer, Leipzig, 1944).

Schnippenkötter, Josef, und Weyres, Theobald, Physik der Luftfahrt (Ferd Duemmlers, Berlin Bonn, 1937).

Schweizer, P A, & Simons, M, Sailplanes by Schweizer (Airlife, Shrewsbury, England 1998).

Schweizer, P A,Wings Like Eagles (Smithsonian, 1988).

Schweizer, W, Soaring with the Schweizers (Rivilo, 1991).

Selinger, P, Segelflugzeuge von Wolf zurn Mini-Nimbus (Motorbuch, Stuttgart, 1978).

Serjeant, Richard, and Watson, Alex, The Gliding Book (Nicholas Kaye, London, 1965).

Sheremetev, B N, Planery (DOSAAF, Moscow, 1959).

Sigurdsson, A, Annálar Íslenkra Flugmála (Reykjavik 1987)

Simons, M, The World's Vintage Sailplanes 1908 - 1945, (Kookaburra Tech Publications, Australia, 1986).

Simons, M, Slingsby Sailplanes (Airlife, Shrewsbury, England 1996).

Simons, M, German Air Attaché (Airlife, Shrewsbury, England, 1997).

Smith, J R, & Kay, A, German Aircraft of World War 2 (Putnam, London, 1972).

Stamer, F, Zwölf Jahre Wasserkuppe (Reimar Hobbing, Berlin, 1933).

Stamer, F, and Lippisch, A, Gliding and Sailplaning (Bodley Head, London, 1930, trs G E Startup and F Kinnear).

Taylor, H A, Airspeed Aircraft since 1931 (Putnam, London, 1963).

Teale, Edwin H, The Book of Gliders (E P Dutton, New York, 1930).

Thomas, F, Fundamentals of Sailplane Design (College Park, 1999).

Visse, C & Ravel, C, Histoire des Planeurs Avia (Musee de l'air et de l'espace, 1993).

Volmar, J, I learned to Fly for Hitler (Kron Publications, 1998).

Wenham, F W, Aerial Locomotion (First Annual Report, Aeronautical Society of Great Britain, London, 1866).

Welch, A, Happy to Fly (Murray, London, 1983).

Welch, A, and Welch, L, The Story of Gliding (Murray, London, 1965).

Weyl, A R, Fokker, the Creative Years (Putnam, London, 1965).

Wills, P, On Being a Bird (Max Parrish, London, 1953).

Wright, L, The Wooden Sword (Paul Elek, London, 1967).

Zacher, H, Studenten forschen, bauen & fliegen (Akademische Fliegergruppe Darmstadt, 1981).

Zanrosso, G, Storia ed Evoluzione dell'Aliante (History and Evolution of the Glider). Volumes 1, 2 & 3 1996, Egida Edizioni, Vicenza

Zbiorowa, P, Konstrukcje Lotnicze Polski Ludowej (Wydnawnictwa Komunikasji i Lacmosci, Warsaw, 1965).

Zipper, G, Falkenhorst (Weishaupt, 1999).

Zumyatin, V M, Gliders and the Art of Gliding (Moscow, 1974, translated from Planery i Planerizm, NASA).

Zuerl, W, Günther Grönhoff und die Goldenen Jahre des Deutschen Segelflugs (Walter Zuerl, 1976)

Periodicals

Aeronautics (UK)
Aeroplane (UK)
Aeroplane Monthly (UK)
Aero Revue (Switz)
Aerokurier (Germany)
Aircraft (Australia)
Aircraft Engineering (UK)
Air Enthusiast (UK)
Australian Gliding
Bungee Cord (USA)
Der Segelflieger (Germany)
Flieger (Germany)
Flight (UK)
Flight International (UK)
Flugsport (Germany)
Gliding (UK)
Jahrbuch des Deutschen Luftfahrtforschung
Journal of the R Ae Soc (UK)
L'aerophile (France)
Luftfahrtforschung (Germany)
Modellismo (Italy)
Modelist Konstructor (USSR)
National Geographic Magazine (USA)
NSM (National Soaring Museum, USA)
Planeur (Belgium)
Quiet Flight International (UK)
Sailplane and Glider (UK)
Sailplane and Gliding (UK)
Soaring (USA)
Technical Soaring (OSTIV,USA)
Tekhnika Vozdushchiogo Foma (USSR)
Thermik (Germany)
Vintage Aircraft (UK)
VGC News (UK)
ZFM (Zeitschrift für Flugtechnik und Motorluftschiffahrt)

INDEX bold page numbers reffer to drawings

ABC Sailplane 239
Abrial 187
Academic Flying Group at Münich 132
Aero tow 34, 65, 73, 154, 209
Aero towings 66, 227
Air 100 128
Air brake 80
Air Training Corps 168, 173
Airspeed Company 160
Airspeed indicator 28, 96
Airspeed Tern 160-**161**
Akademische Fliegergruppe Darmstadt 25
Akaflieg Aachen 140
AL 3 198, **199**
Alan Cobham´s Air Circus 97, 112
Albatross 1 229
Albatross 2 229
Ållebergs Sailflying Museum 87
Alps of Switzerland 66
Altimeter 28, 96
America 34, 44, 59, 70, 73, 89, 94, 96, 102, 213, 229
Anfänger 106
Anhedral 80
Antonov, O. A. 246-247
Asiago 198
Aspect ratio 17-18, 20, 24, 26, 28, 30, 34, 62, 80, 93, 124, 145, 147, 162, 209, 246
Atalante 134
Augsburg 72
Australia 49, 91, 96, 130, 150, 162, 165, 168, 173, 178
Austria 4-5, 78-82, 128, 152-154
Austria 2 152-**153**
Austria 3 152, 154
Austrian Alps 156
Avia 10a 187
Avia 40P 187, **189,** 191
Avia 41P 132, 187, **188,** 191

B gliding certificate 47
Baby Albatross 229, **230,** 231
Bad Warmbrunn 85
Ballast 26, 49, 94, 168
Baltic Republics 206
Bannes d´Ordanche 152
Baranowski 213
Barbot 24
Barnaby, Ralph S. 226
Barograph trace 30
Barringer, Lewin 244
Bauer, Karl 128
Baynes, Jeffrey L. E. 162
Beach, Mike 30, 104, 106
Bedall, Karl 24
Berlin 9, 59, 70, 73, 75, 120, 122, 128, 136, 194, 213, 218
BGA 160
Bienen, Theo 140
Blaue Maus (Blue Mouse) 12-13, 17, 24, 140
Blech 145
Bley, Robert 75-76
Blue Wren 165
Boom Tail SGU 1 - 6 239
Bordina 246
Botsch, Albert 26, 28
Bouvier 187
Bowlus Albatross 82, 227, **228,** 229
Bowlus Super Sailplane 229
Bowlus, Hawley 82, 226-227, 229, 231
Brautigam, Otto 122, 128
Bremer, Karl 24
Bristol Fighter 24
British Air Force of Occupation 110, 120
British Gliding Association 62, 160, 176
Brno 76
Broomstick 24
Brzezina 213
Budapest Technical University 196
Buenos Aires 70, 75, 94, 96
Bungee 12-13, 20-21, 34, 47, 66, 68, 99, 148, 176, 182, 192, 227
Burktraum 85
Buxton, Mungo 162, 168, 171, 176

C five minute soaring test 47
Cadet 173, 176
Cadet Mark 3 176
Cambridge **181,** 182
Camphill 6, 178, 182, 202
Canada 206
Canard 20, 50
Canguro Palas 202
Cape Cod 30, 32, 226
Captain Olley 21
Carden Baynes Auxiliary 162-163
Carden, Sir John 162-163, 165
Casein glue 150
Centro Studi ed Ezperience per il Volo a Vela 198
Ch - 2 Duha 184
Channel crossing 178
Chanute 30-34
Charles, Frank 178
Chatham 65
China 7, 206
Chlup, J. 186
Choisnet, Marcelle 191
Clark Y 66
Cleveland Air Race 122
Cobham´s Air Circus 97, 112
Collins, Eric 110
Combegrasse 21, 187
Condor 1 **74**
Condor 2 76
Condor 2A 76, 132
Condor 3 76
Condor 4 76
Consecutive loops 196
Convection currents 58, 65
Crested Wren 165, **166,** 168
Crimea 24, 30, 246
Croydon 65
Cumulus clouds 34, 58-59
Curtiss Wright Technical Institute 229
CVV - 4 Pellicano 198, **200,** 201
CVV 6 'Canguro' 128, **201,** 202
CW - 2 206
CW 5 186, 209, 211, **212**
Czechoslovakia 72, 76, 114, 120, 184
Czerwinski, Waclaw 206, 209, 211, 213, 215

D - 17 Darmstadt **33**
D - 19 Darmstadt 2 34, **35,** 37
D - 30 Cirrus 147, **149**
D - 31 148
D - 6 Geheimrat **25**
D - 7 Margarete 26, **29**
D - 9 26, **29**
Dagling 44-45, 47, 49, 89, 173
Daily Mail 21, 65
Darmstadt D - 17 30-31, 33
Dart Aircraft Company 182
De Havilland Technical School 160
Decker, Chester 229
Delta 1 **55**
Desoutter, Louis 89
Deutsche Forschungsanstalt für Segelflug (DFS) 56, 72, 104, 112, 122-124, 126, 128, 130, 136
Deutscher Luftsport Verband (DLV) 47, 56, 104
Deutsches Museum 17, 134, 147
Dewoitine 24
DFS Meise 128, 136
Dickson primary 44, 47
Dittmar, Edgar 61, 73
Dittmar, Heini 72-73, 76, 106, 215
Djävlar Anamma 38-39, 50, 106
Dolphin soaring 80

Donnerstag-Klub 85
Dornier 18, 50, 59
Du Pont, Richard 32, 82
Dual instruction 49
Dunstable 42, 89, 104, 156, 168, 176, 178, 182
Dunstable Sailplane Company 168
Dupont, Richard 229
Duralumin 136, 187
Dynamic soaring 13, 58

E - 3 20
Earle Duffin 157
Eaton, Warren 229
Edgar, Larry 244
Edith 20-21
Electron alloy 148
Elliotts of Newbury 130
Elmira 34, 89, 102, 114, 120, 213, 226-227, 229, 237
Emilyanov, V. 246
End plates 50, 52
England 7, 12, 21, 34, 42, 44, 49, 56, 61, 65, 76, 78, 80, 89, 97, 102, 106, 110, 112, 114, 124, 126, 154, 157, 160, 165, 168, 173, 176, 182
English Channel 65, 178
EON Olympia 130, 173
Ermenegildo Preti 198
ESG 31 **86**
ESG 29 40, 85
Espenlaub, Gottlob 18, 20, 38, 40, 50, 52, 229
Eta 80

Fafnir 65-**67**-73, 80, 106, 110, 117, 124, 209, 215
Fafnir 2 'Sao Paulo' 70-**71**
FAI (Federation Aeronautique International) 128 152, 218, 244
Falcon 56, 168, 229
Falcon III 56, 168, **169**
Falke 50, 54-**57**, 59, 65, 106, 168
Falke Rva 56
Farnborough 124
Farner, Willi 218
Fasold 152
Fieseler, Gerhard 61-62, 229
Finland 34, 130, 206, 209
Firle Beacon 21
Fischer, Hans 82
Five digit series 134, 176
Flaperons 80, 82
Flinsch, Bernhard 147-148
Flugwissenschaftliche Vereinigung Aachen 10
Focke Wulf 128
Fokker FG - 2 **22**
Fokker D - 8 24
Fokker, Anthony 20-21
Fox 168
France 21, 68, 82, 102, 128, 130, 152, 154, 178, 187, 191-192, 233
Franklin PS - 2 229
Franklin Utility 34
Frise type ailerons 136
Führinger, Josef 156
Fukuoka 203
FVA - 1 Schwarzer Teufel 10
FVA 1 10, 13
FVA 10 140
FVA 10A 140, **141**
FVA 10B **142**

Garmisch 114
Geheimrat 18, 20-21, 25, 198
Georgii, Walter 58-59, 61, 65, 70, 73, 89, 104, 128
Gewitter Max 59
GN - 7 215, 246, **248**
Golden Eagle 150-**151**
Golden Wren 165

Göppingen 97, 99, 101-102, 157
Göppingen 1 Wolf 97, **98**
Göppingen 2 99
Göppingen 3 99, 101
Göppingen 5 157
Gora, Tadeusz 215
Gorokhova 246
Göttingen 527 187
Göttingen 532 76
Göttingen 535 28, 82, 85, 187
Göttingen 549 61-62, 124
Göttingen 646 194
Göttingen 652 66, 80, 106, 168
Gövier 102-**103**
Gövier 3 102
Gövier V2 102
Grau, Otto 99, 114
Griesheim 59, 82, 84, 104
Grönhoff, Günther 52, 54, 65-66, 68, 73
Groshev 246
Grunau 38-40, 56, 85, 87, 89, 91, 93-94, 96-97, 99, 110, 123, 136, 150, 156, 171, 173, 176, 182, 203, 206, 218, 229, 231, 244
Grunau 6 40
Grunau 8 40
Grunau 9 38-**39**-40, 203
Grunau Baby 87, 89, 91, 93-94, 96-97, 99, 110, 123, 150, 156, 171, 173, 176, 182, 206, 218, 229, 231, 244
Grunau Baby 1 **88**
Grunau Baby 2 **90**
Grunau Baby 2b **92**
Grunau Baby 3 93
Grüne Post 47
Grzeszczyk, Stefan 209
GS - 4 244
GS - M 244
Guggenheim School of Aeronautics 237
Gulf of Finland 209
Gull 65-66, 70, 73, 94, 101, 106, 112, 117, 119-120, 128, 136, 154, 157, 171, 176-178, 182, 186, 191, 196, 198, 205, 209, 213, 221, 229, 233, 246
Gull wings 66, 157, 205
Gust energy 13, 15, 18
Gutermuth, Hans 25
Gutermuth, Professor Max Friedrich 25

H - 17B 157
H - 28 157
H - 28 II 157, **159**
H - 28 III 157
Habicht 120-**121**-123
Haller Hawk 59, 61
Haller Hirth Sailplane Manufacturing Company 229
Haller, Gus 34, 61, 227
Hannover Technical University 15
Hanworth 65, 78, 80
Hardwick, Espin 168
Harris Hill 34, 229
Harth-Messerschmitt **19**
Harth, Friedrich 17-19
Harvard Glider Club 239
Heidelstein 18
Heinemann, Hans 114
Helios 136-137, **139**
Hentzen, Heinrich 15, 20-21
Hesselbach, Peter 30, 38, 226
Heyn, Klaus 65, 109-110
Himmeldunkberg 61
Hirth, Wolf 18, 30, 34, 37-38, 44, 61, 65, 68, 82, 87, 89, 93-94, 96-97, 99, 101-102, 110, 112, 123, 128, 157, 187, 196, 203, 227, 229
Hitler Youth 47, 93
Hitler, Adolf 47, 70, 93
Hjordis 168-169, **170**, 171, 176
Hjordis 2 176
Hofmann, Heinrich 30
Hofmann, Ludwig 96, 112, 114, 122, 128
Hols der Teufel 38, 104-**105**-106, 173

Hoppe, Fritz 26
Horten I 143
Horten II 143
Horten III 143, **144**, 145
Horten III C 143
Horten III D 145
Horten IV 145, **146**, 147
Horten IVB 145
Horten V 145
Horten VI 145, **146**
Horten, Reimar 143
Horten, Walter 143
Hug, August 218, 221, 224
Huth, Heinz 122
Hütter, Ulrich 156
Hütter, Wolfgang 102, 156
Hütter 17 156
Hütter H - 17 156-157, **158**

International Championship 124, 128, 171, 176, 184, 209
ISTUS (Internationale Studienkommission für Segelflug) 84, 114, 128, 134, 140, 154, 156, 194
Itford Hill 6, 10, 12, 15, 17, 21, 24, 28, 30, 34, 40, 47, 54, 58-59, 78, 154, 227, 229

Jachtmann, Ernst 128
Jacobs, Hans 38, 104-106, 110, 112, 114, 117, 119-120, 122-124, 126, 128, 130, 196, 213
Jancsó, Endre 196
Japan 99, 101-102, 203, 205
Jarlaud, Raymond 187, 192
Jones, David 176
Joukowsky 28, 34
Jungfrau 66, 114, 218

Kahlbacher, Toni 156
Kaltgezogener Elephant 80
Karakan 192-**193**-194
Karch, Ludwig 134, 136
Karch, Reiner 134, 136
Kartachev 246
Kassel 34, 40, 61
Kauffmann, John 233
Kawabe 205
Kegel, Max 58-59
Kelsey, Howard 231
Kenichi Maeda 203
Kensche, Heinz 136
Kestrel 168
Kimura 203
King Kite 171, 176, **177**
Kirby Gull 176-177, **179**
Kirby Kadet 173, 175, **174**
Kirby Kite 171, **172**, 182
Kirby Petrel 178-179, **180**, 181
Kirby Tutor 173, **175**, 176
Kirchheim 123
Kittyhawk 7, 226
Klemm 65, 80, 203
Klepikova, Olga 246
Klieforth, Howard 244
Kojcan, Antoni 206
Komar 206-207, **208**, 209
Kr 1 152
Kracht, Felix 140
Kraft, Erwin 124
Krakow 140
Kramer, Fritz 73
Kranich **118**, 119-120, 128, 130
Kranich 3 128, 130
Krietern Meteorological Observatory 94
Kronfeld, Robert 59, 61-62, 65, 68, 73, 78, 80, 82, 124, 152, 154, 178, 187, 192
Kü - 4 80, **81**
Küpper, Dr. August 80, 152
Kurahara 203
Kyushu Imperial College 203

L'Aigle de la Banne (The Eagle of la Banne) 191
La Falda 76
Laister, Jack 233, 236
Laminar flow 145
Latin America 70, 73, 89, 94, 96
Laubenthal, Paul 30, 34, 38
Lawrence Institute of Technology 233
Lawrence Tech Sailplane 233
Le Bourget 154
Leusch, Willy 13, 15
Lilienthal, Gustav 7, 9
Lippisch, Alexander 18, 38, 40, 44, 47, 49-50, 52, 54, 56, 58-59, 61-62, 65-66, 68, 70, 72-73, 80, 85, 104, 106, 123-124, 132, 143, 168, 209
LK - 10 233, **235**-236
LK - 10 A (TG 4A) 233, 235
LNE - 1 244-245
Loessl, Eugen von 9
Loessl, Margarete von 26
London 42, 65, 106, 165
London Gliding Club 42, 106
Long Island 114
Lore 30, 34, 37
Luftkurort Poppenhausen 106, **107**
Luftwaffe 114, 120

M - 22 196-**197**
MacCready ring 128
MacCready, Paul 128, 213, 236
Madelung, Georg 15
Maeda 703 203, **204**, 205
Maier, Otto 104
Major Petre 160
Maneyrol, Alexis 21, 24
Manhattan 114
Manuel, Bill 165, 168
Marabu 54, 65
Martens, Arthur 17, 20-21, 24, 30, 38, 40, 198
Maurer, Sigbert 224
Me 163 72, 123
Meakin, Joan 97, 112
Meise 128-**131**, 136, 198, 203, 213
Melk, Suzanne 191
Merlin 134
Messerschmitt 110 123
Messerschmitt, Willi 17-20, 38, 50, 72, 123
Mg - 1 154
Mg 19 156
Mg 19a-c 156
MG 23 156
Mg 9a 154, 156
Milan Polytechnic 198
Minimoa 99, **100**, 101-102, 171, 203
Mississippi State University 147
Moazagotl 68, 82, 93-**95**-96, 99, 101
Mole, Edward 162, 196
Monte Sisemol 198
Moritz 24, 30, 38, 198
Moswey 124, 224-225
Moswey 2 224
Moswey 2A 224
Moswey 3 224-**225**
Moswey 4 224
Motor sailplane 134
Motz, Gottlieb 94
Mü 13 124, 134-**135**, 213
Mü 13D 136
Mü 13D - 3 136
Mü 17 136
Mü 17 'Merle' 136, **138**
Mü 3 Kakadu **79**, 80
Müller, Georg 224
Müller, Heiner 224
Munich 66, 70, 80, 134, 136, 147, 152
Munich Deutsches Museum 134
Münich Mü 10 'Milan' 132-**133**
Murray, H. 168
Musger MG-9 154-**155**
Musger, Erwin 154-156

Musterle 34-35, **36,** 37, 61, 65, 87, 93, 96, 229
Muttray 70
Mynarski 215

NACA 132, 148, 176, 198, 205, 233, 244
NACA 0012 198
NACA 2412 244
NACA 4 digit series 148, 233
NACA 4514 198
NACA 64016 205
NASA 52
National Geographic Magazine 226
National Soaring Museum 229
National Socialistische Flieger Korps (NSFK) 49, 93, 128, 130
National Transport Museum Budapest 194
Nehring, Johannes 'Bubi' 26, 30, 34, 38, 58-59
Nemere 194-**195**
Nessler, Eric 187, 191-192, 218
Netherlands 84, 128, 130
New South Wales 150
New York City 34, 89, 114, 227, 229
New York World Fair 213
New Zealand 165
Nilsson, Billy 128
Northrop Company 147
Norway, Neville Shute 26, 160

O'Meara, Jack 32, 34, 87, 227, 229
Oberschleissheim 99, 122, 134, 147
Obs **69**
OE - Kamerad 154
Oeltzchner, Rudolf 76
OK - Mario 186
Old Timer Group 123
Olympia 128-131, 173, 203, 236
Olympic Games 114, 120, 130, 194, 218
Olympic Orlik 213, **214**
Olympic sailplane design jury 136
Orlik 213
Orlik 2 213
Orlik 3 213
Osaka Mainichi 203
Osann, Hans 84
OSTIV Congress 147

P - 51 145
Parachute 68, 76, 82, 112, 114, 145, 244
Paris Aero Club 233
Paris Air Show 246
Pegasus 40, 44
Pelzner Hang Glider **8**
Pelzner, Willy 9-10, 13
Persson, Per Axel 128
Petretschenkova 246
Peyret 21, 23-24
Peyret Tandem 21, **23**-24
Philipp, Ernst 54
Pod and boom 148, 231
Poland 128, 140, 206, 209, 215
Pons 182
Poppenhausen 50, 106
Prachar 186
Prandtl, Ludwig 28, 66
Pratt Read G - 1 244-**245**
Professor 25, 59, **60,** 61-62, 85, 106, 206
Professor Arthur Proell 15
Professor Von Karman 10
Prone pilot 120, 143, 145
Proppe, Tassilo 37
Prüfling **43**
PS - 2 226, 229, 246, **247**
PWS (Podlaska Wytwornia Samolotow) 213, 215, 217
PWS 101 213, 215, **216**
PWS 102 215, **217**
PWS 102 Rekin (Shark) 215

Racek 184, 186
RAF 32 168
Rams-horn vortex 9
Raspet, August 236
Rastorguyev, Viktor 246
Raynham 24
Reiher 123-124, **125,** 126, 176, 215
Reitsch, Hanna 89, 110, 117, 122-124, 215
Rheinland 132, 140-141
Rhön 7, 9, 13, 17-18, 24, 26, 30, 37-38, 40, 50, 54, 58, 66, 68, 70, 72, 75, 80, 82, 87, 91, 94, 101, 104, 106, 110, 117, 124, 128, 136, 140, 143, 152, 156, 209, 218, 221
Rhönadler 106-107, **108,** 109-110, 178
Rhönbussard 110-**111**-112, 114, 196
Rhöngeist 50, 58, 61
Rhön-Rossitten Gesellschaft (RRG) 40, 44, 47, 50, 56, 58-59, 65-66, 70, 73, 85, 104
Richardson, Geoff 150
Richmond 65
Riedel, Beate 68
Riedel, Peter 38, 58, 65, 68, 70, 76, 110, 114
Riverside Park 34
Robin 206
Robinson, John 213, 236
Roemryke Berge 58
Rohrbach, Adolph 17
Rolle, Emile 91
Ross Stephens RS - 1 236
Ross, Harland 236, 239
Rossevelt Field 114
Rossitten 24, 34, 40, 44, 50, 65, 91, 104
Rot Front 7 246, **250**
Rotter, Lajos 192, 194
Royal Hungarian Aircraft Repair Works 194
RS - 1 213, 236-237, 239
Rüdiger, Herbert 91

S - 10 18, 20, 38
S - 18 218
S - 18 II 218
S - 18 III 218
S - 8 18
S - 9 20
S.18 T Chouca 218
Sahara 84
Salamandra 206, **207,** 246
Salzburg 84, 117, 128, 132, 134, 140, 152, 156, 191
Sandmeir 221
Sato, Hiroshi 203, 205
Savtov 246
Scharfoldendorf 110, 147
Scheibe, Egon 132, 134
Schempp, Martin 59, 93, 97, 99, 102, 110, 112, 128, 157, 196, 203, 227
Schempp-Hirth 93, 97, 102, 110, 112, 128, 157, 196, 203
Schleicher, Alexander 38, 50, 56, 104, 106, 110
Schlesierland 85, 87
Schloss Mainberg 30, 34
Schmetz, Ferdinand 140
Schmidt, Kurt 91, 124, 134, 136
Schneider, Edmund 38, 40, 56, 85, 87, 89, 91, 93-94, 96
Schneider, Harry 93-94, 96
Schreiber, Herman 218
Schulz, Ferdinand 24, 34, 65
Schwatze Düvel 10-**11**-13, 17, 140
Schweizer brothers 30, 237
Schweizer SGS 2 - 8 (TG - 2) 244
Schweizer SGU 1 - 6 237
Schweizer SGU 1 - 7 239, 241
Schweizer, Ernie 237
Schweizer, Paul 237
Science Museum London 165
Scott, Roy 182-183
Scud 162-163, 165
Scud 2 162, **163**
Scud 3 162-163, **164,** 165
Seeadler 110
Seele, Hermann 112
Segelflugzeug Rhön 106
Segelflugzeugbau Kassel 40, 61
Semmering 152
Senator 85, 91
Sezze 128, 130, 213
SG - 3 209, **210**
SG - 3/bis 36 **211**
SG - 38 4-5, 47, **48,** 49
SG 21 Lwow 209
SGS 2 - 12 **243**-244
SGS 2 - 8 **242,** 244
SGU 1 - 6 **240**
SGU 1 - 7 **241**
SGU 1 - 19 239
Siepen, Howard 226
Sikorsky 244
Silesia 38, 96
Silver C 54, 91, 165, 184, 186, 191, 194, 209, 229
Skullsplitter 38, 44, 106
Sky 2, 6, 34, 128, 227
Slingsby Gull 4 128
Slingsby, Fred 47, 56, 89, 168, 171, 173, 176, 178, 182
Smithsonian 229
SNCASO 191
SO - P1 **190,** 191
Solo training 47, 49, 173, 227
South Africa 102
South America 102
Spain 120, 128
Spalinger 15 218, **219**
Spalinger 18 218, **220,** 221
Spalinger, Jakob 218, 221
Sparrow 206
Späte, Wolfgang 124, 128
Sperber **113**
Sperber Junior **116,** 117, 122
Sperber Senior 114-**115,** 117
Spies, Rudolf 26
Sproule, John Stanley 173
Spyr 1 218
Spyr 2 218
Spyr 3 132, 218-219, **222**
Spyr 4 221, **223**
Square law 13
Stakhanov, A. G. 246
Stakhanovetz 246, **249**
Stamer, Fritz 38, 40, 44, 47, 49, 52
Stanavo 87, 89, 97
Starkenburg 30, 82
Stephens, Harvey 236
Stephenson, Geoffrey 178
Steyskal 186
Storch 50-52, 54, 65, 70, 143
Storch IV **51**
Storch VIII **53,** 54, 65
Stressed skin 15, 17
Strolch 24, 38
Student, Kurt 7, 10, 13, 21, 26, 38, 47, 132, 168, 233
Stummel Habicht 123
Stuttgart 97
Suchla, Theo 38
Super Albatross 231, **232,** 233
Super Falke 56
Sweden 34, 85, 87, 128
Szokolay, András 196

Tauschegg 156
Technical University of Lwow 209
Teichfuss, Luigi Frederico 198
Teutoburger Wald 62
TG - 3 244
TG - 32 244-245
TG - 4 233, 236
TG - 4A 233, 236
Thames Estuary 65
Tiltman, Hessell 160
Tissandier Diploma 218
Tokyo 203
Towing gliders with aeroplanes 229
Troeger, Tony 134
Tulak 37 184-**185**
Turn indicator 82, 96
Turul 196
Tutor 173, 176
Type 23 Kite 1A 173
Type 26 Kite 2 173

Udet, Ernst 112, 114
University of Aachen 10
University of Göttingen 17
Ursinus House 50
Urubu Obs 70
US Army 233, 244
US National Championship 34, 191, 213
US Navy 244
USSR 24, 130, 215, 246

Vampyr 15, **16,** 17, 20, 24
Variometer 34, 59, 61-62, 65, 68, 96, 123, 128
Vauville 24, 30, 187
Vergens 128
Vesuvius 152
Viking 182-**183**
VMA 200 Milan 128
Volker 30
VSB - 35 184, 186

Wandering albatross 58
Warsaw Aerodynamic Institute 209
Wash in 148, 176
Washout 30, 52, 66, 73, 101, 148, 176, 178, 198, 205, 246
Wasserkuppe Museum 106, 109-110, 123
Wave lift 94
Weihe 126-**127**-128, 130, 202
Weltensegler **14**
Weltensegler GmbH 13
Wenk, Friedrich 13, 20, 50, 65, 94, 96
Westpreussen 30, 34, 37, 58
Whitcomb, R. T. 52
Wien 62-**63**-65, 73, 80, 104, 124, 187, 192, 227, 229
Wiesenbaude 1 85
Wiesenbaude 2 85
Willow Wren 165, **167,** 168
Wills, Philip 6, 61, 102, 130, 162, 168, 171, 176
Windspiel 82-**83**-84
Winglets 52, 70
Winter Olympic Games 114
Winter War 130
World Championship in 1954 202
World War 2 38, 76, 93, 102, 120, 126, 134, 136, 145, 157, 162, 168, 173, 194, 209, 215
Württemberg 30, **31,** 37, 187
WWS (Wojskowe Warszaty Szybowcowe) 206

Yankee Doodle 233, **234**
Yankee Doodle 2 233
Yellow Witch 130
Yugoslavia 206, 209

Zabski, Zbigniew 209
Zanonia 236-237, **238,** 239
ZASPL 209
Zeppelin - Staaken Company 17
Zögling 40-**41**-44, 47, 49, 54, 106, 227

This book, Volume 1 of a projected series, describes and illustrates more than 120 types of sailplane, designed, built and flown in many countries during the quarter century following the first organised gliding competition on the Wasserkuppe in 1920. The astonishing achievements of designers and builders, lacking modern materials and production methods, and the flights made by the pilots of those times, deserve to be recorded and remembered.

New scale drawings, produced in digital form, show structural details with colour shading to indicate the materials used. Exact dimensions, cross sections and profiles are included. There are more than 300 authentic photographs, many previously unpublished. The textual commentary draws attention to significant trends and developments in sailplane design.

This book will prove a rich source of accurate information for scale modellers, who were much in mind when making the drawings and selecting photographs. To fly most of the sailplanes described here, the only way now is to build a large scale radio controlled model.

ISBN 3-9806773-4-6
9 783980 677349