Constantinos Pikros

Gliders made in Greece

Athens 2016

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Contents

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Preface

This book is about gliders, not about sailplanes.

There is no well-defined difference between a glider and a sailplane. A glider has inferior performance than a sailplane. In theory, a glider just glides down to the ground, while a sailplane can soar using up-droughts. Military gliders could not be characterised as sailplanes. The space shuttle was also a glider, or rather a motor-glider, but not a sailplane.

Very roughly, every sailplane with an L/D less than 20 could be called a glider. Every glider with an L/D better than 25 could be called a sailplane. Today no sailplane is produced with an L/D less than 30. Some decades ago an L/D around 20 was good enough for sailplanes, as for example the venerable Schweizer 1-26.

We could say that the line between a glider and a sailplane is somewhere between L/D = 20 and 25. There is no regulation containing such a definition.

The difference between gliders and sailplanes is not just technical. It is not just a problem of performance. It is also a linguistic problem. Some languages use different words for those flying machines. Others don't. In Attachment A you can find some information on the linguistic problem.

Around the globe there are many pilots who have the dream of fun-flying in complete freedom. There are others who consider a privilege to deal with traffic controllers, regulations, and restrictions, as airline pilots do. This book was written for the freedom dreamers.

When teaching glider pilots, I always included in my presentation the following photo (Fig.[1]). It pictures a small hill, a small car and a simple glider (small is beautiful). It pictures the complete freedom of gliding. It was shot somewhere in Russia, I suppose in the vast expanses of the Ural Mountains.

1

Introduction

About a century ago the natives of the British Islands were ruling the world. They founded a paramilitary youth organization known as boy-scouts. The idea was so good, that most other countries followed. They used the same British colonial myths (eg. Mogly) and they wore about the same British uniforms. They differed mainly in the headpiece.

In the 1920ies a similar youth organization appeared in Germany. It was not the youth of the army but the youth of the Air Force. It was called *Segelfliegen* (gliding). The idea was so good, that many other countries followed. The gliding movement started with the intention to keep the youth busy with flying activities. They used the simplest aircraft available, the glider.

The glider was a flying machine with very limited range. In the times when the primary glider appeared, the powered aircraft was already fully developed. The primary glider was not a precursor of the airplane. It was a simple substitute for the youngsters to play with.

In order to promote the youth movement, gliding needed its own myths, its own heroes. They were the few grownups who were pushing the simple birds to their limits. Records, champions, heroic flights, were glorified by the gliding propaganda around the world. This is how the cross-country dream was embedded in the European youth imagination.

WW2 was followed by decades of peace. The paramilitary youth organizations were not needed any more, but the gliding movement had gained enough momentum to keep on attracting new members. It was after the retirement of the pre-war generation that the gliding movement began to decline.

The modern youth did not follow the old propaganda dreams. The dream of motor-less cross-country flying remained with the few fanatics of contemporary soaring and their super-sailplanes. They will be even fewer in the years to come.

In the contrary, the dream of simple flying was always there. Unfortunately the soaring movement abandoned the dream of simple flying and stuck to the dream of records and racing.

How many sailplanes are produced every year in the whole world? Maybe less than 500. Half of them are expensive motor-sailplanes. Who is buying expensive motor-sailplanes? Few rich grownups who still believe in the old dreams of their fathers.

In theory soaring could become a jet-set sport. There are other trendy, fancy, snobbish sports around. Why not soaring? Can soaring attract the "*nouveaux-riches*" of the world? Not a chance. Pushing sailplanes on open fields is not the image that most "*nouveaux-riches*" would like to build for themselves. Having somebody to support your wingtip as if you were crippled is not a jet-set image either.

The target group of soaring seems to be the higher age group. It is no more the younger generation. This was the result of collective choice by the soaring movement.

The boy-scout movement had to make a similar choice. Some decades ago we have been helping the Greek scouting, in order to introduce gliding and sailing as advanced youth occupations. The head of the boy-scouts movement considered the danger of transforming the boy-scouts groups into sport clubs. Their decision was crystal clear: "We remain a youth organization".

The soaring movement has never decided what soaring is. Soaring slipped into sporting, but not quite. It is not a full competitive sport either. There have been two occasions when soaring was heading towards the Olympic Games. In both situations soaring backed up. Soaring was not to be a full sporting activity.

Today soaring is no more a youth organization, as gliding has been in the past. It is not a growing sport either.

Contrary to soaring, there exist today other very active gliding movements. They are called hang-gliding and para-gliding. They are gliding in its purest form. When hang- and para-gliding activities appeared in the last decades of the 20th century, the soaring movement did not consider them as simple inexpensive gliding, but as other lesser sports. Most youngsters joined these lesser simple gliding sports, and not the expensive and complicated soaring movement.

Landing space, air space, registration, airworthiness, insurance, medical certificate, pilot's license, instrumentation, ratification, all these words mean trouble and expenses for today's soaring sportsmen. They mean nothing to the simple flyers of hang- and para-gliding. It is no wonder that most youngsters prefer the lesser gliding sports.

The soaring troubles were added gradually one at a time, so that sailplane pilots accepted them with little complaining. The youngsters of today are confronted with all soaring troubles at once. They are not ready to accept them.

There has been some work in the soaring society to introduce something simpler than the super-gliders. It was called the World Class. It was a class designed to give you the same troubles as before, with less performance. Naturally, it failed. The PW5 (the Word Class glider) was not what Prof. Piero Morelli was working for. He tried again with the UL glider class. It was also a disappointment.

The UL-glider was seen by the soaring movement as a new class to claim new records. It was seen by the soaring movement as a way to claim the existence of new (!) thermals (called microlift). Claims, claims, claims that do not interest the young generation any more. Gliding claims were the prewar dreams. You cannot revive a dying movement with old dreams.

Modern gliding cannot be based on super-UL-gliders like the "Carbon-Dragon" or the "Sparrowhawk". Such gliders can break all records of some FAI racing category, but they are not suitable for youngsters to play with. Yes to play with, like they can do with the simple para-gliders.

Can we turn back the clock to unregulated traditional gliders as a sport? No, we cannot.

Training with single-seaters is successful with para-gliders, because a para-glider has much more stability than a glider (it also has much less controllability). A glider pilot needs much more training than a para-glider pilot. He needs a two-seater trainer.

Training with single-seater gliders (like the pre-war primaries) has proven to be a utopia. Training must be done with two-seaters. Two-seaters have to be well regulated. Deregulation can be applied only to single-seaters. This was very well documented in the “applicability” section accompanying the brief FAR-103 regulation of 1982.

Without the possibility of having suitable trainers, modern ultralight gliders could not evolve into a sport for new pilots. It could only be the deregulated playground for trained sailplane pilots (licensed or not). Today, US and European regulations tend to define 80 kg as the empty weight under which single-seaters do not need licenses and permits. This opens possibilities not as a new sport, but as an interesting glider pilot's toy.

Commercially speaking, there is no interest in producing something inexpensive, unless it can be mass-produced. As gliders cannot be mass-produced, there is no commercial interest in building simple gliders. Only expensive sailplanes are commercially available, either new or used. If you like to enjoy a simple and light glider, you have to turn to amateur construction.

The French homebuilders club was promoting the idea: "*construire pour voler*". This idea is misleading. *C'est peut-être vrai pour les avions légers, mais ce n'est pas vrai pour les planeurs. Si vous voulez voler sur un planeur, ne le construisez pas vous-mêmes. Achetez un planeur d'occasion du grand marché Allemand. Construisez seulement pour le plaisir de construire.* This means that you build a glider mainly for the pleasure of building it.

In the following chapters we will unfold the story of the gliders which have been built in Greece. Gliders imported to Greece are out of the scope of this book. You can see all our gliders in the "Hellenic Soaring Archive" in the Internet site (www.marinaalimos.gr/hsa). For Greek readers the book "*Ανεμοπορία και πολεμική Αεροπορία*" (Gliding and the Air Force) has the detailed story of the gliders in Greece. It can be downloaded in .pdf format from the site (www.aerodata.gr).

The story of building gliders in Greece begins in the early 30ies. In the first decades, locally built gliders were useful flying machines. The sportsmen of gliding enjoyed building the gliders, flying them and repairing them. As we will see, in the last decades the gliders became useless, so it was only the pleasure of building that prevailed.

Part 1 – The useful gliders

Pre-war primary gliders

The first glider arrived in Greece in 1932. It was a German built Falke which was kept out of reach of the youngsters. Training glider pilots started in 1934 with two locally built Zögling primaries. Till 1940 about 30 gliders were in use. Than came the war. The war destroyed all our pre-war effort.

You can find many pictures of the pre-war gliders in action in our "Hellenic Soaring Archive".

In the 30ies, building gliders was a "wood and fabric" story. All gliders have been locally built. They were mainly of the Zögling family, the conventional German version (fig.[2]) and the version with 4 tubes for the tail (fig.[3]). Grunau Babies and Grüne Posts have also been built in Greece from local aircraft factories (the private Anton Raab factory and the state's KEA factory). The Raab's Grunau Babies had an oval aerodynamic nose and not the hexagonal nose section as in the original drawings.

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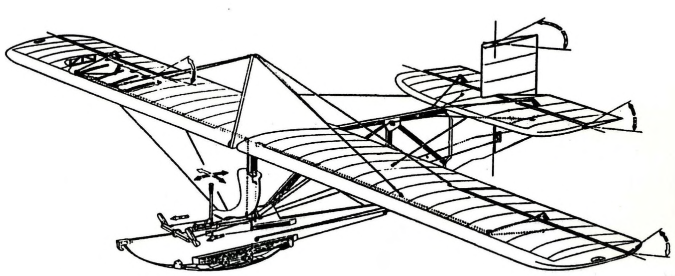

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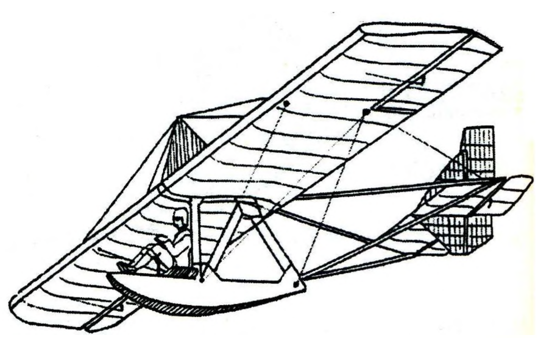

No photo survives of the Raab factory, or of glider manufacturing in the KEA factory. KEA was a military factory and no pictures were allowed anyway. The only pictures that survive of glider building in the 30ies are two photos (fig.[4] and [5]) of around 1938. They depict a Zögling glider being built in the Faliron Gliding Club near the KEA factory.

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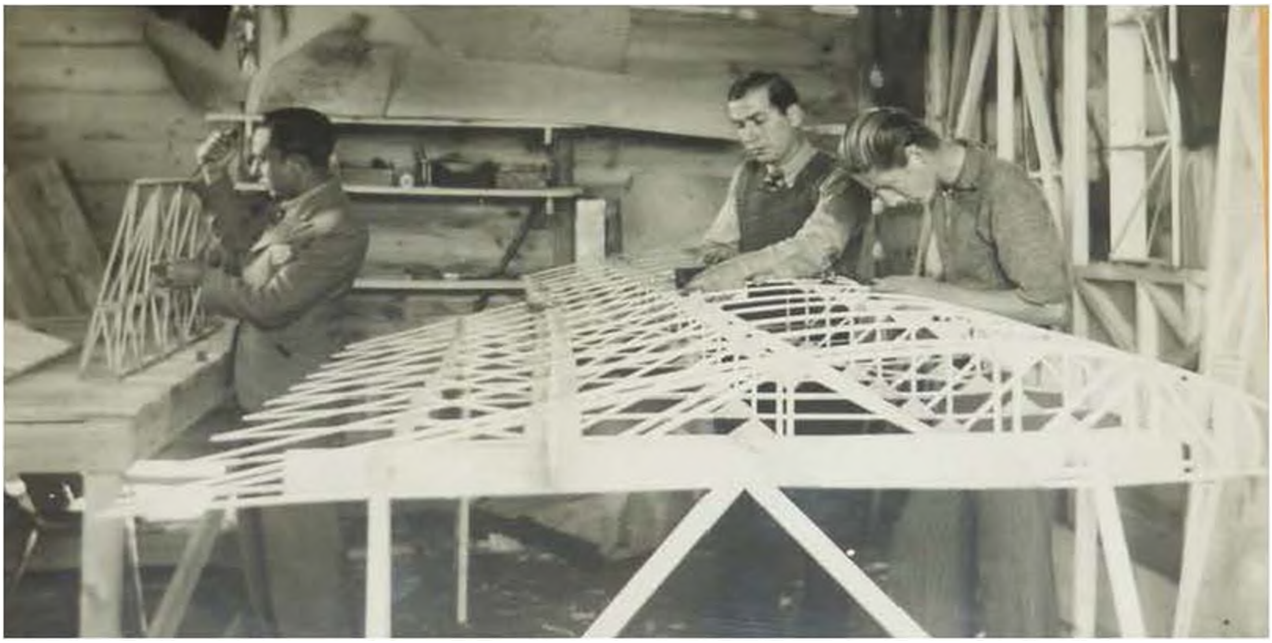

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We also have a very small picture of people working on a Zögling's wing, in open air. Our information is that this picture was shot in Thessaloniki (fig.6). The gliding team of Thessaloniki was not a branch of the local Aeroclub, but of the local boy-scouts.

6

Primary gliders after WW2

After the war an old Zögling was restored in Athens to start flying again. It was known as the "Glaraki" (meaning: a small gull). In Thessaloniki a pre-war Vrona-bis was also restored. It was known as "Gria Vrona" (meaning: the old lady Vrona). The Thessaloniki movement was short lived.

In (fig.7) you can see the "Glaraki" glider ready to fly in the north of Athens in a slope which is now a densely built urban area. Note the typical composition of the slopes, which consists of soil mixed with stones.

7

We also have a primary glider built after the war. It was designed during the war and built in 1950 by George Peschke in Athens. It was a blend of the Zögling and the Jackob's primary. A 3view drawing of the Peschke primary survives today (fig.8). It was known as the "Glaros" (meaning: seagull).

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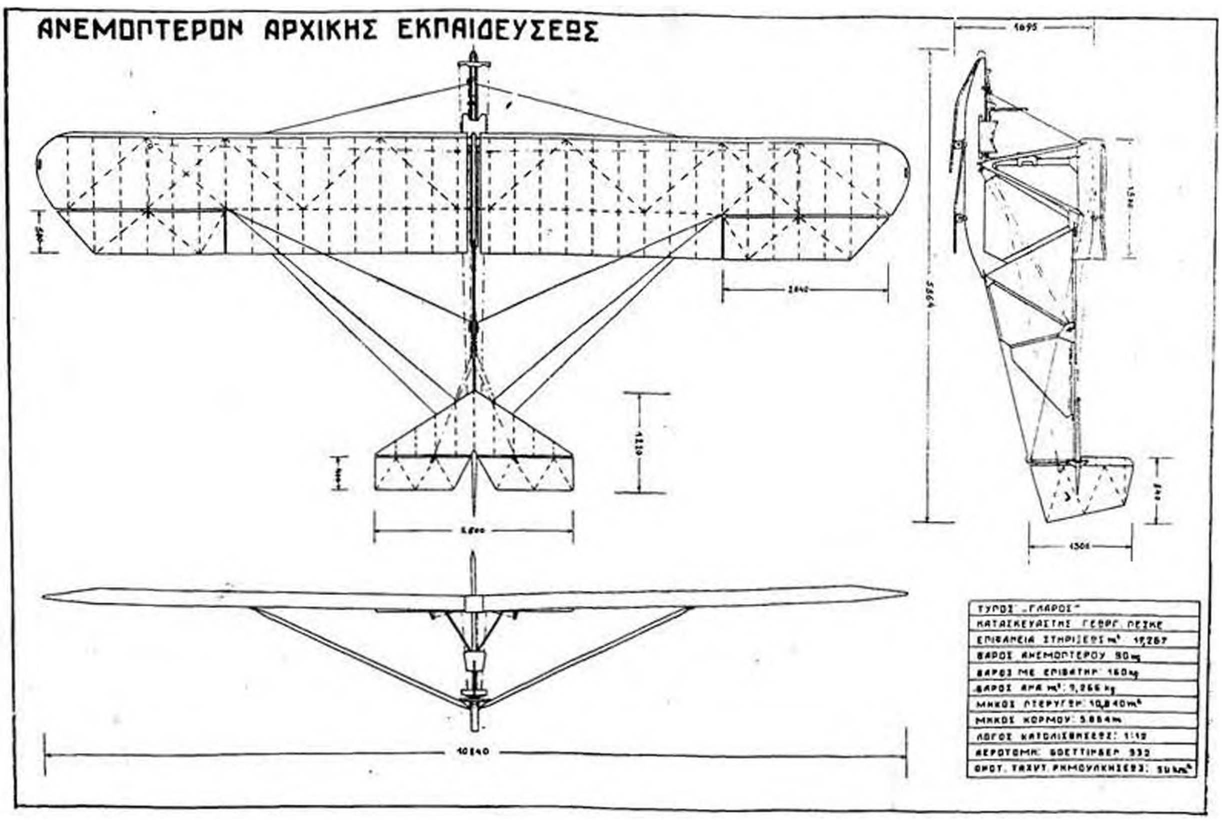

The "Glaros" glider replaced the old "Glaraki" in the slopes around Athens. There exists no photo of the two flying in the same day. Many photos of the "Glaros" operating (fig.[9]) exist in our "Soaring Archive".

9

A scaled down Zögling

Alexander Avdis had his first flights before the War on a Zögling. He restored the first Zögling that flew after the war and he took part in the construction of Peschke's "Glaros". After the war he was a technician of the KEA Air Force factory.

In the spring of 1950 he received an order to build a model glider for crown prince Constantine. It took the factory 20 days to complete an exact 2/3 model of the Zögling. It was given by the Air Force as a present to the prince at his name-day (fig.[10]).

The real Zögling had an empty weight of 130 kg, which gives a gross weight of about 220 kg. With a weight scale of $1/\lambda^2$ the 2/3 Zögling might have had a gross weight of 100 kg in order to fly with the same speed as the original.

10

The 2/3 Zögling had an empty weight of 60 kg. This left 40 kg for the pilot. As the typical weight of a 10 years old boy is about 40 kg the 2/3 Zögling could have flown with the crown prince. This was never attempted and the fate of the glider is unknown.

This has been a scaled down glider for a scaled down pilot.

The picture of Constantine on the 2/3 Zögling was hanging in the offices of our Royal Aeroclub. In the '60ies prince Constantine visited the aeroclub as a young officer of the Air Force and he had his picture taken in front of his old picture on the 2/3 Zögling (fig.[11]).

11

The 2/3 Zögling was the second Greek royal glider. The first one was a full scale Zögling built before the war for Prince Paul (the father of Constantine) who was an airplane pilot. The glider has been staying idle in the Gliding Club of Athens, until some youngsters of the club used it in the slopes of Menidi. The glider was damaged and this provoked some anxiety in the club.

When price Paul learned about the damage, he just had a good laugh for the prevailing anxiety.

The Čavka gliders of the 50ies

In the 50ies the "Royal Aeroclub of Greece" had good relations with the Yugoslav gliding authorities. Gliding sportsmen have been trained in Yugoslavia in 1953.

The Čavka (pronounced Chafka) was a Yugoslav design based on the Polish Salamandra glider. The drawings of the Čavka glider were redrawn in Greek language. Ten Čavka gliders were built in the KEA factory in Faliron (suburb of Athens by the sea). Between 1955 and 1960, five of them were used excessively in the "Tripoli Gliding Center" (fig.[12]).

There are many pictures of the Čavka in Tripoli, but no picture of the Čavka manufacturing survives (no cameras were allowed in the KEA factory).

Fortunately during the demolition of the KEA factory, a draftsman saved a full set of the Greek Čavka's construction drawings. We received them through the boy-scouts, and we immediately produced transparent photocopies in order to secure their survival in multiple copies. Lately the

12

originals have been scanned.

If you have more interest for those gliders you can read a recent book written on them. It is titled "The Čavka gliders in Greece". You can download it in .bdf format from the address: www.aerodata.gr/pdf/books/346/346.pdf

The book contains the story of the gliders (in English and Greek), as well as the construction drawings issued by the KEA factory in Greek language.

The Roda glider was a two-seater trainer, using the same wings as the single-seater Čavka. No Roda trainer was built in Greece. Three of them were imported from Yugoslavia.

The Čavka gliders in the 70ies

The Tripoli training center stopped operating in 1960. After some flights in Athens in 1962 the Čavka and Roda gliders were stored. They were replaced in 1961 by contemporary sailplanes (the Polish Bocian as a trainer).

In the mid 70ies we were training in Athens with an ASK-13 sailplane, but we had no spare trainers to give to other clubs. When we met with the president of the new aero-club of Edessa (Macedonia), we learned that most members of the club were former Tripoli students. We revealed to them that we had in our stores some Čavka gliders that were built in KEA and have never been used.

13

In 1975 an old Roda (fig.[13]) was repaired and two Čavkas put together. We used the registrations of no-more-existing old Tripoli's Čavkas. So the aero-club of Edessa started flying using outdated gliders. In 1978 you could fly a brand new fiberglass Glassflugel Mosquito in Athens and an old wooden Čavka in Edessa (fig.[14] next page). Both were great fun to fly.

In the 80ies the Čavkas were abandoned. Some still remain stored around Greece for sentimental reasons. You can find more details in the "Čavka gliders in Greece" book. Currently a Čavka and a Roda are being restored in Edessa to be displayed as museum pieces.

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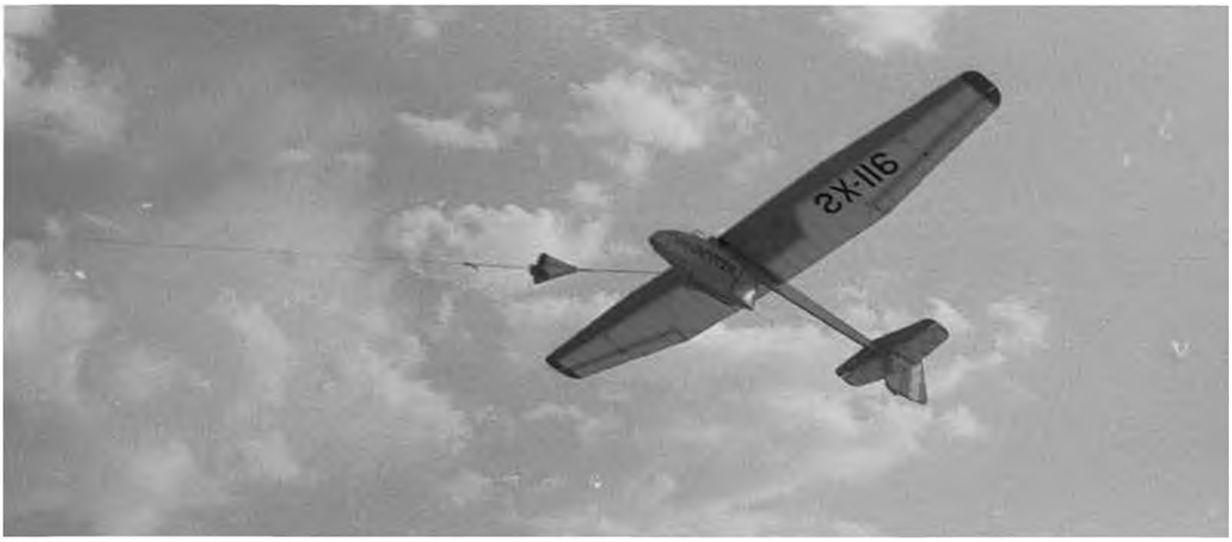

From 1960 until today, all sailplanes in Greece were imported. Only a few experimental gliders were locally built. They were built by pilots who were already flying sailplanes in the clubs. They knew very well what a low performance glider could be. They just liked to enjoy the experience.

The "Gliding fish"

A sea-glider is a tempting project. Greece is a place for summer vacations, with steep rocky coasts, with patches of sandy beaches, and a variety of sea breezes. Flying with the seagulls in the coastal up-drafts is a challenge.

In many oceanic coasts there is a tide. When the web retreats, wide sandy beaches are uncovered and can be used as airfields for ordinary gliders. In the Mediterranean Sea we have no tides. If you intend to land along the coast, it will be on the sea. For operation by the coast you need a sea-glider.

A motorized flying boat is a project with many problems and needs a powerful and heavy engine. It is said that "a flying boat is neither a good airplane nor a good boat". On the contrary a sea-glider towed by a motorboat, can be built light, as an experiment in the field. As in all gliding operations a powerful engine can be on land, or on a boat, or on another aircraft. That is fine, as long as the noise and the exhaust fumes stay far away from us.

Building a sea-glider is an interesting experiment. As the possibility of failure is considerable, it is better to build something simple.

Around '68 Platon Kourouvakalis (just Platon to make things simple) had a workshop in Athens where he was building a Bebe-Jodel, a French homebuilt airplane. His workshop was the meeting place for many friends discussing technical problems of the air. Among other ideas a sea-glider was much talked about.

15

We started preliminary drawings for a sea-glider. Platon's drawing was for a two-seater. Mine was for a simpler single-seater for just a quick experiment. I even built a small model of the single-seater fuselage (fig.[15]).

Plato was intending some commercial operation. So, he started building his two-seater. He did the drawings of the flying part (fig.[16]). I did the drawings of the boat part. Bending the flat plywood to produce the planning hull for a sea-glider was no different on the drawing board than lofting the lines of a plywood speedboat. The same can be said for the calculations of the waterline, the total buoyancy and the location of the centre of buoyancy, to be matched to the centre of gravity of the glider.

The flying part was designed by Platon on the safe side regarding the planform, the airfoil and the tail-feathers. The glider was built by common materials of the local market, mostly 5,5 mm marine plywood and Oregon Pine wood (fig.[17]). Some day I asked Platon about the final span of the glider. He just measured the length of the timber he had found in the market and proudly announced the official span. You can read the final dimensions in Platon's 3view drawing (fig.[18]).

Around this stage we also decided the official name of the glider "Anemopsaro" (gliding fish).

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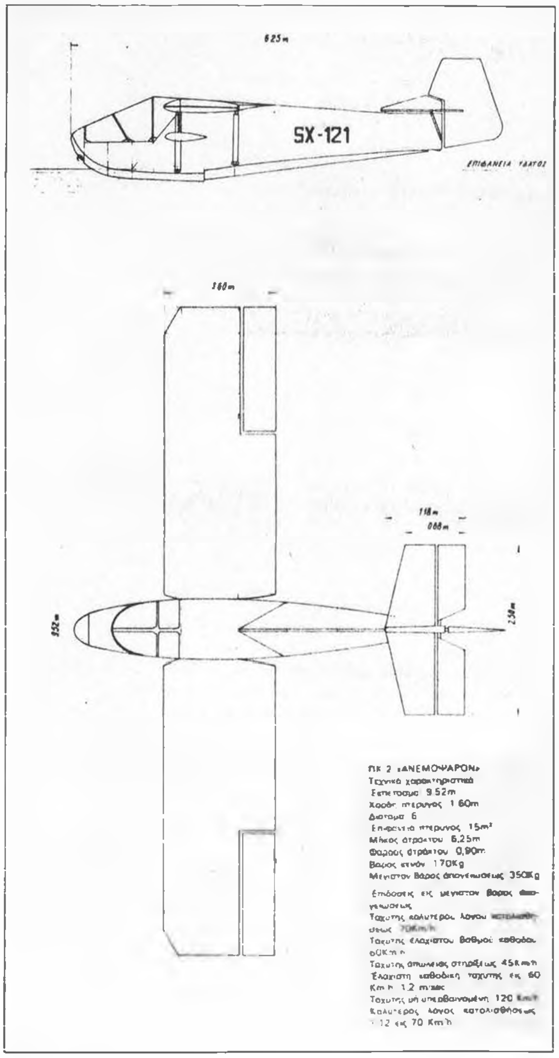

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In 1977 the "Gliding Fish" had its first flights in the Faliron Bay in front of the Royal Yachting Club (fig.[19] next page). For the first flights the "Gliding fish" had no floats under its wings (fig.[20]). The wing tips were floating anyway. The floats were added in the following days.

After the flights of the first day, we returned to the beach where we were met by high-ranking coastguard officers. Fully manned rescue vessels were also arriving. The coastguard had received telephone calls that an airliner has been seen ditching in the bay.

The flights continued in the following weeks without further coastguard alarms (fig.[21]). In one occasion Platon met a small piece of driftwood that went through the thin bottom skin of the hull. The cockpit was transformed in a small swimming pool where Platon was swimming. The wooden glider was unsinkable anyway.

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After some more flights in Oropos (in the north of Athens) the "Gliding Fish" went to Ioannina Lake, in NW Greece.

We found no problem in flying the ship, no problem in taking-off or landing. The main problem, that we did not expect, was the immense drag of the tow-rope in the water. For more than fifty meters of rope, the powerboat could hardly attain take-off speed. After take-off, you had to pull hard to unstick the rope from the water. A drum on the powerboat could unreal the rope. But the whole operation was complicated enough.

In the next years, Platon tried to transform the "Gliding fish" into an amphibian, by the addition of two small fixed wheels. In the first such flight the thin sidewalls where the wheel brackets were fixed on the fuselage, gave in. The sea-glider was abandoned for good.

The fate of the "Gliding fish" was decided by its light hangar. In a winter storm the small hangar fell on the "Gliding fish" which was damaged beyond repair. The glider was high on its trailer, and this protected the more valuable material around it.

The project of the sea-glider towed by a motorboat was not a good idea. There is however another possibility for the rocky Greek Islands: A glider launched (catapulted) from the mountains by the sea and landing on the water in front of a beach. It is an interesting project for anyone having 3.000 work-hours to spend for one more experiment with doubtful results.

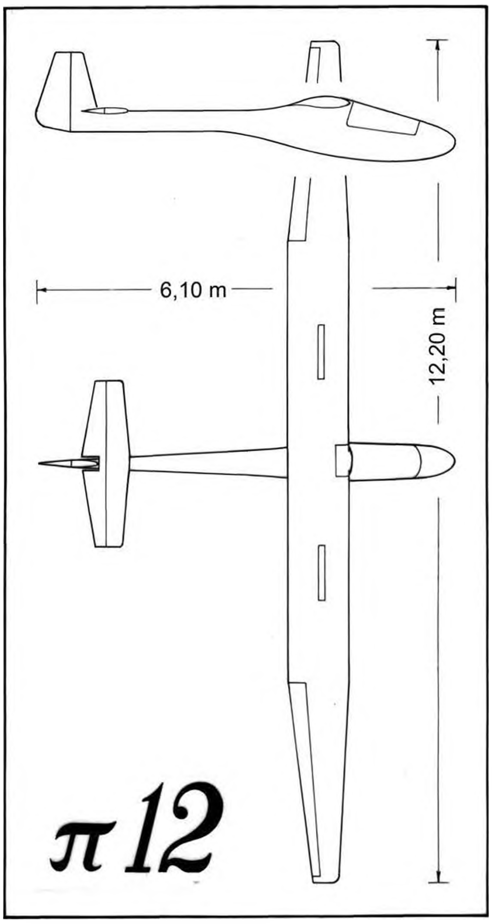
The π12 glider

In 1976 soaring in Athens was at its high. A friendly soaring community was growing in the club and many building projects were considered. One of them was the construction in Greece of some low performance sailplanes for solo flying. Low performance was considered an L/D of around 20 and a minimum sink of around 0,8 m/s.

The wooden Duster glider was considered, but it was found difficult to build due to its complicated metal parts. The designer of the Duster had probably the same thoughts, as he later designed the much simpler Woodstock. At the same time, wood was gradually being abandoned in glider constructions. Fiberglass was taking over.

Our first preliminary drawings were for the π10, a 10m span light glider using the high lift airfoil FX63-137. As the then existing data for the airfoil were only for low Re number, professor Wortmann himself was asked on the matter, through a Greek student of aerodynamics in Stuttgart. The answer was strait: "Do not use the FX63-137 airfoil, as this is suitable only for wingtips". After this divine oracle, the wing profile was changed to the conventional FX61-184 airfoil and the span had to grow to 12m. So the π12 glider was born (fig.[22] and [23]). The well-known symbol π (=3.14) was used to denote the Greek origin of the project. It was also the first letter of the surname of the father of the project Pikros (*Πικρός*). We immediately proceeded in performance calculations, drawings for the fuselage shell (full-scale stations) and detailed drawings of all the metal fittings of the sailplane.

Fiberglass was the chosen building material. It was considered at that time, that the sailplane could be easily reproduced after considerable amateur work invested in building the plugs and the moulds. The plug for the fuselage was built with much enthusiasm and with much amateur work (fig.[24] and [25] next page). Then work came to a stop. The member of the π12 team on whom the fiberglass work depended, started looking at the project with less amateur attitude.



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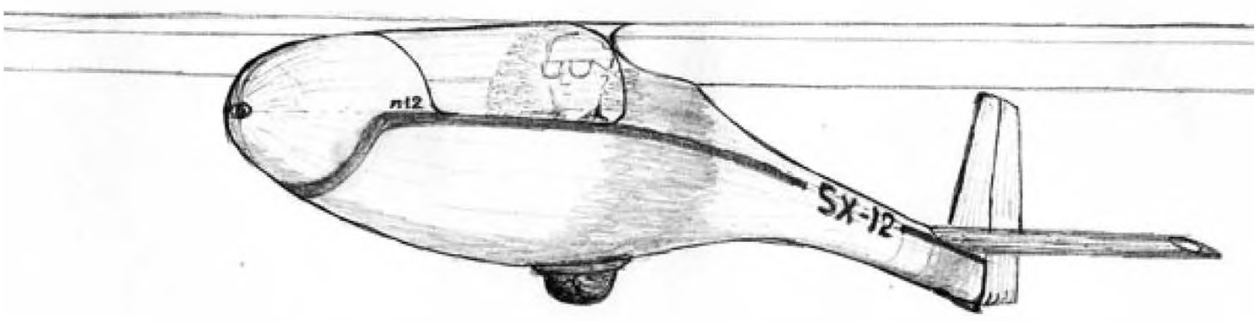

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In 1979 aeronautical engineer T.Spathopoulos joined the π12 team and the project entered a new phase. The amateur project was turned into a research project. Many state and university institutions were contacted for further financing of the construction. Results were negative. At the end, ship owner Panos Laskaridis adopted the project. He had no illusions of an industrial sailplane production. He just wanted to have a team that has proved it can produce aircrafts. Those were productive years for Greek industry and many talks were on the air about the Air Force planning for a locally built trainer.

The π12 was a project born in the Gliding Club by pilots needing a glider to fly on. Gradually it was transformed into a project for engineers needing an aircraft to experiment on.

26

The π12 project took a new boost. Engineer Theodore Spathopoulos proceeded in the control and stability calculations and engineer George Pintelas worked on the structural design. At this stage, a new conservative decision was made. As nobody in the team had experience in dealing with vacuum technology, the fiberglass wings were abandoned in favour of conventional aluminium wings. A couple of experienced metal workers from Olympic Airways started working a few hours per week building first the jigs, then the three-piece wing. Their work was expensive but first quality (fig.[26]).

At the same time a professional fiberglass boat builder built the fuselage mould (fig.[27]). A trip I had to "SZD-Bielkso Biala" factory to fly the new Puchacz trainer of the club, resulted in good relations with the Polish engineer Adam Meus. He proposed a better set of fiberglass layers for the π12 fuselage shell than was originally planned. At last, the shell was laid up by Claude Friedman an able aeromodeler (fig.[28]).

Around the end of 1984 two sets of wings were almost ready. Only the connection fittings and the controls were missing in order to close the last

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aluminium sheets. All the metal fittings of the fuselage were built. The pilot's seat and the instrument panel too.

On the other hand there were also some failures. The stabilator was built by a young engineer of the team, using an aluminium spar and polystyrene foam covered with fiberglass and a lot of filler to smooth its surface. It was extra heavy. The elevator and rudder were hastily built in aluminium by the same engineer, as if it was for a jet fighter. He did not consult the rest of the team and did not even think of weight and balance. Bending the canopy's acrylic sheet in a bath of heated oil was also a failure. In fig.[29] the wooden frame of the canopy is being trimmed.

These were independent pieces that could be easily rebuilt. But the project had already used a lot of money (e.g. many years of rent for the workshop). At the same time the people involved had acquired careers with little time to spare. The prospects for aircraft manufacturing in Greece for the Air Force seemed now as remote as ever. The Air Force ordered trainers from the USA. The π12 project was abandoned for good. It has been a very instructive experience for the whole team, both the amateurs and the professionals.

Part 2 – The useless gliders

Useless aircrafts

Aircrafts are built to fly. The reason of building an aircraft is: creating something that flies. An aircraft that does not fly has no use. It is useless.

Normally an aircraft loses its use when it is deemed unserviceable or uneconomic. Then, it does not fly any more. It remains on the ground and its fate is uncertain.

A possible fate of useless aircrafts is their dismantling and the recycling of their components. In every airport there is a remote corner where useless aircrafts are deposited. They are finally transformed into pieces suitable to feed the foundries. There are though some useless aircrafts that remain in the hangars or on the tarmacs. Instead of "useless" they are called "display items" or "museum pieces". Their content is no longer indispensable and could be replaced by straws as in stuffed birds. Their main interest is their outside shape and decoration.

We just described the fate of aircrafts that became useless after a long and intense operation. There are aircrafts though which become useless after very few flights. This is the case of many contemporary homebuilt aircrafts.

Back in 1964 I was a student at the Technical University of Athens. In our gliding club we had a prewar glider pilot, engineer George Pangakis. In fig.[30] he is depicted in a prewar photo, ready to take off on a Grüne Post. He invited me in his office and introduced me to the design of light aircrafts. We used his prewar German books and started performance calculations for a light aircraft he called the "Teufel". We did not proceed to the structural analysis of the wooden aircraft, but since then I consider G. Pangakis as my instructor in aeronautics.

There are many things that my instructor taught me on gliders and airplanes, but there is one thing that I have not stopped repeating since: "If you consider building a flying machine, think of something that will fly for many years. Do not build an aircraft to fly once or twice and than be stored as a museum piece". This was the sad fate of all the gliders of Part 2 of this book.

Around the world there have been many useless aircrafts that were built from the beginning as "display items". Such aircrafts have many advantages. To begin with, their weight doesn't matter much. If they are not meant to takeoff, they can be built from heavy materials that you would not use in a normal aircraft. It also does not matter if their weight is well distributed along the aircraft.

30

Such aircrafts are usually built with colorful decorations. They are full scale static models of non existing flying machines. As there is no museum for such items, after being photographed from any angle with the proud owner and without him, they are abandoned in the dusty corner of a hangar.

On the other extreme, there are useless aircrafts claiming to be extra-ultra-light. The strength of such aircraft does not matter much. You can build an extremely light and fragile aircraft and be very proud of it. You can recognize such aircrafts very easily. No such aircraft has ever been submitted to static loading tests.

Some decades ago, I was approached by a friend asking for help. In his town somebody had built a very light aircraft of his own design. He desired to have some calculations to find out if the aircraft was strong enough to fly.

My reply was that calculations are made before construction. "If the airplane is already there, just turn it over and load it with sandbags". By fear of losing their aircraft, proud owners avoid static loading by all means. There are people who prefer breaking their neck, than breaking their empty aircraft.

Many builders of useless aircrafts are not pilots themselves. Very often they rely on some other fool to fly their products. In the first steps of ultra-light airplanes in the US, there have been several accidents when enthusiastic pilots volunteered to fly untested flying machines. Since then, the difference between useful and useless aircraft is not blurred any more. An aircraft that has not been submitted to static loading must be deemed *a priori* as useless.

All this arguing could have been omitted if some homebuilders would admit the simple fact that their hobby is just building aircrafts. Their final intention is looking at their aircrafts, and not flying them. Why do they feel obliged to state their aircrafts will fly? Building static models and mock-ups is not a vice. It is an art.

The Horten Ho-229 was a German delta wing of extreme beauty. It was a complete failure. It was never put in production. Recently a replica was built in the US, in full scale (fig.[31]). Much care was given to the aesthetics of its outside look, as well as its cockpit. Nobody claimed it would fly. They said they intended to find out if the British radars of WW2 could detect its presence. I suppose they had a very nice time building this 100% scale model of the Horten. It is indeed a pleasure to the eyes.

The problem is not only with the builders. It is also with us flyers who think that everything that looks like an airplane must be able to fly. Building is a pleasure by itself, whether it is followed by flying or not.

31

The Zögling gliders again

In the last decades, the revival of the primaries in Greece was boosted by two old-timers, 1) Alexandre Avdis who has flown the Zögling gliders before the war and 2) Pantelis Kalogerakos who had some flights on a Zögling right after the war. These two friends had the dream of building a Zögling glider again. We fliers were dreaming of taking-off on a Zögling, launched by a bungee chord. The two friends did their best to pass their dream to the next generations.

The first attempt

The first attempt for a Zögling replica involved Platon Kourouvakalis. Around the end of the '60ies he intended to build a flying machine. The two friends proposed him the Zögling and provided him with some existing construction drawings. They even gave him the airfoil jig that Avdis had built in 1947 without ever using it.

Platon did not proceed in building a useless Zögling. He preferred to cooperate with Kalogerakos on something much more useful, the Bebe Jodel homebuilt airplane. Platon turned the airfoil jig of the Zögling over, and formed on its flipside the ribs for the Jodel.

In this first attempt nobody built anything concerning the Zögling.

Why a Zögling?

A Zögling today is of no use. If you try to lift its fuselage (fig.[32]) you can understand immediately why a large team of youngsters was needed for its operation. The glider weights around 130 kg when the more recent primary, the "Hippie", weights only 65 kg. Rigging a Zögling for a flight is a very time consuming experience. Why than to build a Zögling?

We have seen a Zögling being aero-towed, which doesn't look safe nor romantic. The romance of bungee-launching by two teams of *Gummiseilhunde* is absent. There remains just the vanity of having a picture of oneself flying a Zögling.

Romance is the only reason of building a Zögling today. Every contemporary glider pilot would like to have the experience of a flight on a Zögling, like the "*avant la guerre*" glider pilots. If you ask: "who would like to have a bungee launch?" pilots will come flocking around. Each one will enjoy his flight and make his escape quietly.

Under these circumstances, a Zögling is bound to fly for one day by its builders and then be stored as a useless vintage aircraft. This is the pessimistic scenario.

According to the optimistic scenario there will be a friendly team who will enjoy one happening every year. It will not be "the day of the Zögling" but "the day of bungee-launching" with the Zögling, the Hippie, maybe also a Čavka. Why not?

Such events are not very rare in Europe. In Rigi (Sweiz) we still see videos of bungee launching once every year, in remembrance of the good old days. In 1957 as a boy, I shot some pictures of a

32

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glider being catapulted from Rigi (fig.[33] and [34]).

The second attempt

Around the end of the '80ies Kalogerakos and Avdis were together in Piraeus, in the local Experimental Aircraft Club (ΣΠΑ). They managed to inoculate the Zögling project to Mike Poulikakos, an airline pilot. He dreamed the revival of a Zögling and decided to finance the project.

The drawings for the Zögling issued by the Royal Aeroclub in 1937 were for some British version of the glider (so was it named by Avdis). Its tail had tubes extending to the tips of the stabilator (as already depicted in fig.3). Not many such gliders were built in Greece. Everybody was in favor of a traditional Lippisch-Stammer Zögling (as in fig.2). So, Avdis redrew the tail of the traditional Zögling and the ΣΠΑ-club issued a new fuselage drawing dated March 1991.

The woodwork of the Poulikakos Zögling was to be built by Nikos Ravanis. He is a glider pilot and a professional carpenter who had already built a SkyPup homebuilt. Following the 1937 drawings, Ravanis built a new jig for the wing ribs. The ribs for the whole project were built on amateur basis by aeromodeler Vassilis Katiniotis, a professional airliner pilot.

In the old days, the steel fittings of the gliders were handmade. In the '90ies I had some experience working with laser-cutters that had just appeared in Greece. I volunteered to draw all the steel fittings of the glider in .dxf format to be sent for laser-cutting. I draw the metal fittings of the 1937 drawings plus some additional parts given by Avdis.

In the meantime, Ravanis completed the woodwork for the fuselage, the tail and the tail-feathers

At this stage, it seamed there was no more interest to complete the project. The timber for the wing spars had been painfully selected by Kalogerakos and stored by another carpenter. The latter was in need of some timber for doorframes and used the selected wood. The lack of space dispersed the pieces of the glider in several places.

The third attempt

The parts of the Zögling built in the decade of the '90ies were stored for many years. In 2005 after the death of his wife, Avdis announced to me that he intended to build a Zögling. Contacts were made with all people involved, without success, so Audis decided to start a new Zögling of his own.

Katiniotis was prompt to build a second set of ribs. He did not use one of the two existing jigs though. Although I draw the airfoil Goe-532 very accurately, Avdis preferred to build a third jig with his own modification on the leading edge. So there existed three jigs but not even one Zögling.

In the summer of 2005 Katiniotis built a second full set of wing-ribs, with the hope that Kalogerakos or Avdis would proceed to the completion of at least one glider. We had until then: 3 jigs, 2 sets of ribs, but no Zögling.

Avdis cut the four spars needed for the Zögling wings, and he started building his fuselage. At the same time I corrected the .dxf drawings in cooperation with both Kalogerakos and Avdis. I gave the drawings to the laser-cutter and in November 2006 I obtained two full sets of steel fittings for the Zögling. I also obtained a *Gummiseil*.

35

Meanwhile Kalogerakos gathered in his workshop in Piraeus all the pieces of the Poulikakos Zögling, but he was not willing to complete the construction there. The pieces were moved once more from Piraeus to the Poulikakos hangar in Avlona, where Ravanis was supposed to complete the Zögling. Many years later not much had been done.

Avdis started assembling the fuselage of his glider in his backyard (fig.[35]). It was not the traditional Lippisch-Stammer Zögling. It was a primary glider with struts, more like the Glaros of Peschke. Unfortunately at that moment, Avdis (born in 1920) began having health problems. His Zögling was stored for good.

Last notes

This is a 50 years story where about six people are involved. Each one of them could finish a Zögling alone in about two years. The project drags for 50 years because everybody understands that the Zögling is a useless flying machine of big romantic value.

Everybody wants to help, but nobody is ready to carry the whole load by himself. What is amazing is not the fact that the Zögling has not been completed for 50 years, but the fact that the project keeps being alive for 50 years.

In 2015 Ravanis is renewing his interest on the Zögling and starts building the wings of the glider (fig.[36]). At last the first set of ribs of 1990 and the metal parts of 2006 are being used.

36

The Hippie

The "Hippie" was a failed attempt by Ursula Hänle to revive the primary gliders. It was not built in Greece but it is a rare specimen that very few people had the chance of flying. We think it was an interesting experience that many friends would like to read about. That is why it was included in this book. The recent restoration of the Hippie is also of some interest for vintage minded flyers.

In 1976 Pantelis Kalogerakos had the intention to bring a "Hippie" in Greece. He financed half of the cost, the other half belonging to a local merchant of aeromodels. The merchant went to Germany and brought the glider to Athens.

Being used to fly certified sailplanes, we assessed the Hippie not to be very trustworthy. Its main spar was just a web without spar-caps. It seamed to be a stressed skin wing. The problem was that the skin was not continuous. It was built by many sections glued together by epoxy putty. We preferred to deal with the Hippie very cautiously. Its manual stated that it was not to be flown in an altitude of more than 50 meters, a rather alarming statement.

A Sunday morning of 1977 we transported the Hippie to the Megara army airport, in the west of Athens. The owners of the glider had invited many friends as onlookers, but also as potential buyers.

We put the parts of the Hippie together. The fiberglass seat frame and the wings where easy to assemble. The tail though had many wires which were rather difficult to assemble. The Hippie was not an easy toy for grownups, as we had thought.

Next, Platon had the first flight using auto-tow (fig.[37]). He quickly climbed to about three meters, but suddenly turned left and made a hard uncontrolled landing. As the glider had already flown in Germany it was obvious that Platon had done something wrong. He tried a second take-off. Results were the same: an easy climb to three meters, a sudden drop of the left wing, and a dangerous uncontrolled landing.

We stopped the operation and tried to imagine what could have gone wrong. On examination, there was nothing wrong with the glider. We dismantled the Hippie and we returned to Athens very disappointed, but also very puzzled.

In the next three days, I spent many hours on the phone speaking with Platon on the Hippie problem. In Wednesday, Platon revealed to me that he did not release the tow-rope because of the left turn. The left turn occurred after he released. The cause of the turn was then obvious: Platon was entering in a left spin.

37

Being used to fly heavy sailplanes, Platon was releasing the tow-rope and continuing some horizontal flight before putting his nose down. The inertia of the Hippie was small and the drag of its tail-wires was immense. The speed fell dramatically after the release and the glider entered a left spin. Our problem was solved. We were ready for the next flight.

Next Sunday we were gathered again in the same place. The onlookers were fewer. They might have been disappointed from the previous flight attempts, or they might have just fed their curiosity on the previous Sunday.

I installed myself on the Hippie against the wind and tried for a while the unconventional hanging control stick. I did not find any problem. Next I had my auto-tow. I kept the glider on tow on a constant height of about one meter from the ground. The controls were responding perfectly. At the end of the runway I released and had a very smooth landing.

Platon had the next flight with the same results. He was followed by hang-glider pilot Nikola Karagiorgi. In the meantime the wind was getting stronger, which was favorable for straight flights against the wind. After the last flight Nikola just stepped down from the glider, as we would all have done from any normal aircraft. The empty ultra-light glider was lifted by the wind. It was turned over and landed upside down.

The damage was minimal. Just the horn of the elevator was bent. But the glider never flew again. It was transported to the store of the merchant where it was hanged from the ceiling

In the following years the Hippie was sold by the merchant to amateur airplane pilot Anton Felouris in Sparta. Some more flightless years passed by for the Hippie, and then Felouris offered the Hippie to the Arcadia Aeroclub in Tripoli. From there it went to a technical school and later to a small hen-growing enterprise.

In 1997 ("20 years after" as Alexandre Dumas would have said) the Hippie was in an agricultural hangar near Tripoli. The hangar was needed to store farm-products and Kalogerakos was called to save the old glider. We went to Tripoli together and obtained the glider. The wings of the glider were full of nut shells. The mice of the hangar were probably calling the wings "home sweet home".

We secured the fuselage of the glider in a garage near Tripoli (fig.[38]) and we brought the wings and the elevator in Athens (fig.[39]). Kalogerakos intention was to repair the canvas surfaces of the glider and put it again in fly-worthy condition. He took the elevator to be repaired in his workshop in Piraeus but left the wings temporarily in a boiler room. From there the wings went to a small shed in the open, where they spent some more months. In the end, the wings were transported back to Sparta and stored in the hangar o M. Poulikakos.

38

39

Until 2010 the wings of the Hippie were in Sparta, the fuselage in Tripoli, and the elevator in Piraeus.

In 2011 Vassilis Katiniotis decided to restore the Hippie by himself. He first gathered all the pieces in one place (fig.40), at his home in Glyfada (suburb of Athens by the sea). He had a small aero-modeling workshop where he planed to restore the Hippie piece by piece. And that is what he did. Time had imposed a lot of damage here and there, but no part was missing.

The smaller parts of the glider could be worked in the workshop, but the wings had to be worked in the open air, on the veranda. Katiniotis made clever arrangements so that he could work half of the wing indoors in the workshop, while the rest stayed outside (fig.41). Some fine alignment work was even done in his living-room, while his wife was not at home (fig.42).

All metal parts were disassembled, cleaned and repainted. The fiberglass part of the fuselage was repainted. Some wires had to be replaced. But the main work was on the wings and the stab.

The wings of the Hippie consist of many sections flash-assembled with epoxy putty. This construction was not deemed safe any more. All the gaps were inspected and refilled with new putty. They all had to be reworked and strengthened by an additional glass tape and epoxy resin.

The rear part of the wing had plywood ribs that had to be replaced. This work came to a halt when Katiniotis departed to work abroad. The Hippie is another vintage glider whose story covers many decades and is not over yet.

41

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42

The "Kiki-7" glider

Initially the "Kiki" was not a glider. It was a pusher ultra-light airplane, something like the Polish "Don Quixote".

Around 2002 Pantelis Kalogerakos was building a "Sourissette", a French homebuilt airplane (fig.[43]). His workshop was a very old two-storey house in Piraeus. In the upper floor he was building the "Sourissette" and we were helping him sporadically, having a very nice time. In the ground floor he started building a box-shaped fuselage. It was a new airplane of his own conception that would later be called "Kiki". It was built in wood plus many parts in extruded polystyrene foam (fig.[44]).

43

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Both the "Sourissette" and the "Kiki" took many years of enjoyable amateur work, without being finished. In the meantime the old house was brought down. In 2006 Kalogerakos moved his workshop to a nearby semi-underground shop, far better than the old house (fig.45).

Kalogerakos is a builder of wooden airplanes. He likes to build the wooden parts of an airplane, but he prefers to leave the engine part to somebody else. It happens that his friends Katiniotis and I we are also very reluctant to dirty our hands in motor oil. So, in 2007 we persuaded Kalogerakos to forget the engine and turn the "Kiki" into a glider, in order to have some flying fun. The three of us went on, to complete the construction of the "Kiki" as a glider.

46

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A ski was installed instead of wheels (fig.46) and a tow-hook was quickly assembled (fig.47). The metal parts needed were available from my own glider (part 3 of this book) that was being built at the same time. In the end of 2007 the "Kiki" was ready for some test flights.

In the last moment Kalogerakos changed the name of the glider from "Kiki" to "7". He claimed that this was his lucky number. We never stopped calling it "Kiki" although this name did not appear on the glider.

In the workshop we had already balanced the glider by putting some lead in the nose. In fig.48 we have positioned a wooden support around the CG of the glider, and are estimating the additional lead required. More lead was ready to be placed on the field, according to the weight of each pilot. There has not been any static loading though.

Before the test flights, we had some reservations on what was to be expected from the aircraft. Katiniotis was worried about the center of gravity being much higher then the ski. His fear was that the "Kiki" might turn turtle on landing. My reservations were on the effectiveness of the rudder. The tower behind the pilot could produce eddies effecting the rudder.

49

In February 2008 the Kiki was transported to the Papadopoulos airfield in Copais (fig.49). Many friends (mostly aeromodellers) were gathered around to help us, or just to watch the show. Many cameras were also present to shoot the event.

As Katiniotis was the most experienced pilot, the first flight was his. We were expecting the glider to take-off at around 55 km/h and this is what the tow-car driver expected. But the glider did not take-off at that speed. We had to accelerate to 70 km/h in order to have a take-off. Probably this was due to the small incidence angle of the wing on the fuselage. As the tail of the glider was low, the wing could not attain enough attack-angle when on the ground.

Another problem arose during the first flight. The tip of the stabilator was touching the ground before the wingtip. In the hard floor of the workshop we had no such problem, but in the field's grass the stabilator tip was dragging down.

One more surprise for us was the immense drag of the ski on the grass. The empty ultra-light glider could not be moved by a single person on the grass.

Katiniotis had two flights at a height of 1-2 meters, just to play it safe. His landings were smooth, with no tendency of turning over. His fears were groundless.

Next I had to test my own fears (fig.50). I also had two test flights, rolling the wings from side to side and holding a steady heading. I found out that the rudder had enough power to keep the heading, against the adverse yaw of the full span ailerons. My fears were also groundless.

50

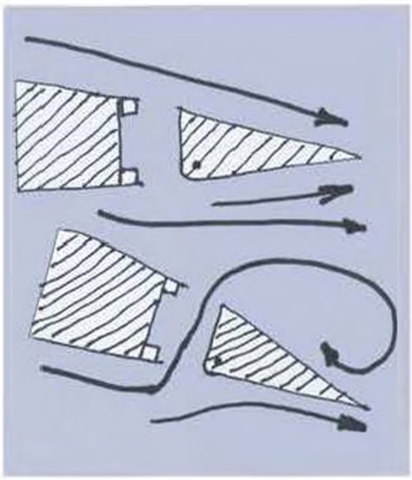
51

During those flights I found a peculiarity in the low speed domain of the flight. As long as the glider was flying at about 70 km/h everything was normal. The problem arose below 70 km/h. When lowering the glider from a height of 2m down to 1m, I tried to stop the decent by augmenting the angle of attack. The glider did not respond well, but touched the ground instead.

The low level flights went on again with Katiniotis, but also with Ravanis. As there was no wind at all, we could use the runway in both directions. That allowed us many test flights for the day.

At the end, Katiniotis took a calculated risk. Although the glider had not had a static loading, he made a flight at a height of about 30m. The first flights have proved that a loading of around 1g was safe. He made a straight-ahead flight, without any turn that could produce higher loads. This flight was very useful for our friends on the ground, who shot pictures of the "Kiki" from below in what looked as a real high flight (fig.51).

During this flight Katiniotis experienced the same feeling of weird uncontrolled sinking when he tried to check his descend in low speed for the landing flare. An explanation could be the wide open gap between the wing and the full span ailerons. In high speed, the flow above the wing was normal. In low speed though and high angle of attack, the flow from below the wing could rush from the gap and spoil the flow above the wing (fig.52).



52

This was only a hypothesis that had to be tested in future flights, after the gap was sealed. At the same time, static loading had to be done before any further flights.

I was looking the "Kiki" as an experimental machine that could give us some more knowledge. Other people were looking the "Kiki" as a nicely painted display item that had given us all the optical experience it could give. The optical material has been compiled by Kostas Katomeris into a very nice video, available in "Youtube". We all had a very enjoyable time with the "Kiki".

The "Kiki" was abandoned and we forgot all about it as a glider. As an airplane, nobody was interested to install an engine anyway. We can also say today that with a pusher engine installed, the "Kiki" would have been terribly tail-heavy.

The "Souriplaneur"

The work on the "Sourissette" airplane was also dragging around the engine installation. The fuselage was ready some years before. The wings have been fabric-covered with much teamwork (fig.[53]). The painting had followed the preferences of the show-minded people of the group. Only the installation of the engine remained, as well as the wheeled landing gear. As the door of the workshop was not large enough, these works had to be done in a hangar. An engine had already been tested on the aircraft during one of the journeys it had out of the Pireus workshop (fig.[54]). The landing gear though was not satisfactory. So, the "Sourissette" remained idle in the workshop.

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Katiniotis and I we proposed to turn the "Sourissette" airplane into a "Souriplaneur" glider, as we had done with the "Kiki". The serious installation of the engine could follow later on, by whoever was interested. One evening in the workshop, after eating a lot of pizza plus some wine, Kalogerakos agreed.

We knew what to do. We had to install a dead weight in the place of the engine, plus to install a ski and a tow-hook. The next day, I started building a heavy nose cone to replace the engine. I used the heaviest hardwood I could find. On this, Kalogerakos had serious objections. "Everything that goes on an aircraft must be aircraft grade", he told me firmly.

The "Souriplaneur" project was stalled for good. Without much interest on aircraft engines, the "Sourissette" never flew as an airplane either and was abandoned. The fact is that it had kept the team together for many years. If we consider it an instrument to gather a team of amateur builders in the workshop, it had greatly fulfilled its purpose.

Le souriplaneur

The "Bro-11" gliders

Back in the 70ies Kalogerakos was finding in the bookstores some issues of the Russian magazine "Моделист-конструктор". It was printed on inferior quality paper, but it contained some very attractive drawings for homebuilt aircrafts. In one of these issues he found the drawings of the "Bro-11M" glider.

The "Bro-11" was a very small glider. It was used by the Soviets as a primary trainer for the younger generation (10-12 years old). It was designed for pilots weighing less than 60 kg. This is why it was a very light glider of small dimensions.

Kalogerakos decided to build a "Bro-11" with his own modifications. In those times he had around him an old man who was light enough to fly it, and eager enough to build it. The modifications had to comply with the abilities of the old man who had limited skills and was not a pilot (fig.[55]). The outcome was not very trustworthy. For example, the leading edge of the wing was not plywood covered as in the original drawings. It was covered in thin cardboard. The empty weight of the glider was only 25 kg. Its Greek name was "Soussourada" (the name of a bird).

The glider was brought to Tatoi airport and stored with the sailplanes of the club. The moisture of the hangar gave to the wings a rather artistic shape. Nobody had the will to fly it. We were told that it flew unmanned as a kite, one day with strong wind. This is rather doubtful.

55

Some decades later, the Soviet Block had disintegrated. Through the Internet we started downloading more issues of the "Моделист-конструктор" magazine and its attractive drawings. We also downloaded a Russian book with many soviet glider drawings. We learned that the "Bro-11M" had a wheel, but the "Bro-11" did not have a wheel and was much simpler. We also learned that the Soviet gliders family "Bro" was designed in Lithuania.

In 2010 the boy-scouts were in search of a project that would upgrade their aero-modeling program. We revived the "Bro-11" idea. The project was not aiming to put the young scouts in the air. It was a construction project to introduce the young scouts in something more sophisticated than the flying models.

We did have the "Bro-11" drawings. We also had the construction manual. But it was written in Russian. The manual was printed and not in digital form. So we could not insert it in a digital translator.

We dealt with this problem together with Harry Mantas the leader of the scouts "Bro-11" team in Thessaloniki (Macedonia).

We did not have access to Russian OCR software, so Mentas carried out the immense task of digitizing the Russian text letter-by-letter on the Cyrillic alphabet. Next, we proceeded to the digital translation of the Russian text. We had more hope in a Russian to English translation then in a Russian to Greek translation. English evolved from a Franco-Saxon Creole without any serious grammar. Translation to such languages is easier then translation to any well structured language.

The outcome of any digital translation of the Russian text (into any structured or not structured language) was not understandable. The text was full of technical terms that the software could not translate. A Greek student of a Russian university gave us his own version which was also not understandable.

In the end, I had to sit down with a Russian lady which had no idea of aeronautical terms, but could give me the general idea of the writing. With all the previous work plus the drawings, I could understand the function of each part of the glider, and give it a Greek name. Very often I had to ask pre-war flyer Avdis about the name they were using for some parts of a glider before the war. If even Avdis did not know, I had to improvise.

After that, we printed the construction manual of the "Bro-11" in Greek. Together with the drawings we produced a nice folder to be given to anyone interested.

Two gliders started being built at the same time. The first one was built in Piraeus, in the Kalogerakos workshop. It included modifications by Kalogerakos. The second glider was being built in Thessaloniki by the team around Harry Mentas. It was to be built much closer to the original drawings.

In Thessaloniki the project was also closer the original aims of the boy-scouts. Some scout-teams visited the workshop and they even went into building some primitive wing-ribs. Unfortunately the Thessaloniki "Bro" was soon abandoned.

The Piraeus "Bro" was built with wide participation of interested people. It was becoming a social event (fig.[56]). Many grownups former scouts came by with their friends, but not a single team of young boy-scouts.

56

57

As a boy-scouts building project, the "Bro" was a failure. As a glider building project, we would better avoid any comment. We would rather talk about the aesthetics of the outcome. The painting of the glider was selected to match the original Soviet colors. Even the big red Soviet star was there. In the end, Kalogerakos added a big number 03 on the glider's tail. This time he did not speak about a lucky number. He admitted that the number was there just for aesthetic reasons.

The Piraeus "Bro" was completed in 2011 and taken by the boy-scouts in Kifissia (fig.57), a suburb north of Athens. It was paraded just once by the boy-scouts on some local festivities (fig.58). It ended as a display item, and you may have already noticed it in Fig.36.

It might not have been interesting for flight-minded people, but it was a great success as a social enterprise, bringing together tenths of people interested in flying machines.

58

The Cretan "Goat"

The mountains of Crete are the home of wild goats called Cri-cri. Among all places in Greece, the island of Crete was the most appropriate for a "Goat" glider to be built.

Until now all gliders we have mentioned were European designs. As most sailplanes and gliders are designed and built in Germany, they all follow the metric system of measurements. Metric components are easily found in the European market. The tools available are also metric. That is why in Greece we are reluctant to work on a drawing giving dimensions in inches and feet.

There are exceptions though. Technicians who had some professional connection with civil aviation, or who had their military service in the Air Force, tend to be familiar with the US standards. In the town of Herakleion (in the north coast of Crete) some technicians of the Air Force started building a "Goat" ultra-light glider around 2010.

The "Goat" glider flying on the cliffs of Torrey Pines California was a dream for every UL minded glider pilot. Taking-off just by rolling down-slope and landing back on top is the purest form of gliding. There are few places around the world where you have such a ridge and a steady strong wind blowing against the slope. Long Mynd in England is one of them. Bezmiechova in Poland is also nice for rolling downhill, although top landing is not possible.

When we learned in Athens that a "Goat" was being built in Crete, we started thinking of places where it could soar. Crete has high mountains, high winds and many paragliders. On its western extremity in Falassarna, there is much slope-soaring by paragliders against the prevailing west winds. The main problem in Crete is landing. There is not enough flat ground where a "Goat" glider could land. Especially in the summer, every flat ground by the sea is covered by tourists.

We have seen that the "Kiki" was an airplane transformed into a glider. The opposite happened with the Cretan "Goat". Against our dreams, the "Goat" glider was transformed into an airplane by the addition of a two-wheeled landing gear (fig.[59]). A 22hp pusher engine was added and the moto-Goat made some low flights in the Timbaki airport of Southern Crete.

The work on the Cretan "Goat" was first quality. We were very sorry that it did not fulfill the goal of its designer. It fulfilled the dream of its builders, which is a great success for any homebuilt aircraft.

59

Part 3 - My own useless glider

In 2002 I had already been flying gliders for 40 years. My main pleasure was instructing. The pleasure of instructing glider pilots is not only the transfer of flying knowledge. It is also the pleasure of teamwork with able students, students carefully selected by the instructor. In a small non-profit flying school an amateur instructor has his own ways of selecting an elite group of students. Some decades ago, glider pilots in Greece have been considered an elite group.

In the end of 2002 I decided that I was old enough, not to run with youngsters pushing gliders on a 2 km taxiway any more. Following the students seated in the club's car (as if I was disabled) was out of the question. So I abandoned club flying and concentrated in ultra-light gliders. After the death of Professor Piero Morelli we have not heard of anybody in the OSTIV (*Organisation Scientifique et Technique Internationale du Vol a Voile*) caring about UL gliders.

The field of ultra-light gliders did not have any commercial interest. So, it was free for amateur investment. Investing much time and little money in UL gliders seemed an interesting project. Recent UL gliders (the Arhaeopteryx, the XXtherm and the Swift) were built as foot-launched. No contemporary gliders were built aiming in bungee-launching. In part 4 of this book you can read the arguments in favour of such a project, as well as the reasoning on the general layout of the glider.

After the project of the π12 glider, I had all the time to review several preliminary calculations and drawings. In 2002 the preliminary work was ready (fig.[60]) and I could begin building the real thing.

60

61

62

Having had the experience of the π12 project, I decided to build the glider by myself and for my own personal pleasure only. I would not allow people to influence me with their own priorities on building aircrafts. I built the glider in a secret place that I called "Peenemünde" (the name of a secret German base of WW2). Less than five persons have ever seen the glider being built.

The name of the project was in accordance to the small dimensions of the glider. I had already built a minimum sailboat the "plangton" (πλαγκτόν in Greek). It was only natural to name the minimum glider "πτίλον". This word is pronounced ptelon (*ptilon en francais, come s'il etait petit et long*). It denotes the very small feathers (dawns) that grow on the belly of birds. You may note that both Greek words begin with the same letter π=3,14 as well as the glider π12 and my surname (*Πικρός*). Well, this is no coincidence.

The construction dragged for many years. In dead winter it was too cold in the workshop. In dead summer it was too warm. Extreme temperatures are not favorable for the setting of epoxy resins. They are also not very favorable for having fun in a workshop. The pleasure of building was the main purpose of the project.

Looking back at my notes I find out that until 1996 I had already completed the basic drawings of the glider. From 1997 to 2002 I was building plugs and molds. From 2003 to 2012 I was working on pieces that would fly. After 2012 I was just dealing with the trailer problem.

In the same period, parallel projects were evolving: two "Zöglings" in the Athens area, the "Bro-11" in Piraeus, the "Hippie" in Glyfada and the "Goat" in Crete. There was also interest in Edessa to restore a Čavka glider. With at least five open glider projects, plus my secret one, the future for UL gliding was looking bright. I was dreaming of the "bungee-cord day" where at least three gliders would meet on a slope every year, just for the fun of it.

In the same time, I was involved in amateur meteorological research. I traveled around the country and investigated the daily evolution of the sea- and mountain-breezes from village to village. This information, added to the experience of the local para-glider pilots and to the knowledge of the sparse meteo-stations, gave us a comprehension of the airflow in the warm months of the year. It also gave us

63

the convergence of the breezes, favorable for soaring flights. The result of this many-years work can be reached in the site www.marinaalimos.gr/smb

The meteorological investigation was combined with the search for mountain slopes suitable for bungee-launching. The results were not encouraging. There were many places for taking-off, but no places at their feet for landing. All sites where primary gliders were flying before the war are now cultivated or planted with trees. Electric water-pumps and the mechanical plow gave many marginal lands available to agriculture. It seams, more food means less gliding.

Meanwhile, the secret work in “Peenemünde” was advancing (fig. 61 page 35). In part 5 of this book you can follow the stages of the work done. Static loading was also realized in the workshop. The glider was ready in about 2012. Its empty weight was 74 kg.

Having covered part the wings and the tail-feathers with Dacron fabric, the glider looked dull. Painting the fiberglass was out of question. I had to put some colour on the fabric and I wanted to avoid the common strait lines of the airplanes. I gave a drawing of the glider to my friend Ilias Biris who is an architect. He proposed to me some interesting ideas. I chose the red designs that you see in the photo (fig. 62). I know people who would have objections to such unconventional designs. In fact, the whole project was unconventional. In fig. 63 the glider is positioned horizontal on wooden supports for balancing purposes.

Unfortunately when my glider was ready to fly, everybody else had abandoned his project. The search of a slope for bungee launching had also reached a dead end. I did not find a Torrey Pines in Greece, not even a Bezmiechova. Flying my glider in an airport behind a tug was aimless. In the airports we could fly much more suitable sailplanes, then a modern old-timer glider. The “πτίλον” glider had no use. It was a useless aircraft. As I liked to avoid the traditional single day show, the “πτίλον” remained stored in “Peenemünde”. I have enjoyed building every part of it.

Fortunately neither the Americans nor the Soviets came to my “Peenemünde” to confiscate any glider parts available and to take with them all the files and drawings they could find, together with any people involved in the project.

For history-minded readers this is the end of the book. Next chapters are just technical.

Part 4 - About the project "πτίλον" (why and what)

During the construction of the glider, I have written some articles on ultra-light gliders, in our local "Aerosport" newsletter. Nobody knew at the time that these ideas where applied in secrecy. The reasoning of building an ultra-light glider, as well as the general layout of my glider, appeared in four articles (issues 38,43,53,90). They were written in English for the purpose to be included in a future book, the book that you are now reading. Here they are combined in a single text:

1) Why are there so few homebuilt gliders?

Building a machine that can fly is not so difficult. Given a powerful enough engine, anything can fly with minimum wings. Even without wings at all, it can fly if you call it a helicopter or a missile.

Building a machine that can use atmospheric up-drafts is something else. You need good aerodynamics. The teachings of the famous homebuilding school "*constructivisme miserable*" cannot be applied in sailplanes. That is the reason why homebuilt sailplanes are so few. But that is only part of the story.

Many homebuilders think that they follow the road to inexpensive flying. There is not such excuse for building a sailplane. Club flying is so accessible that it leaves no unfulfilled dreams. This is one more reason why so few motor-less aircraft are being built.

If you plan to fly an aircraft of your own, you must have a flying license. There are many airplane-homebuilders who have never even flown the kind of bird they dream of building. This is not the case with soaring. As it is easy to join club training, most people who would consider building a sailplane know well what to expect of it. Their expectations tend to be high, higher than home-building can provide.

So we come to the second question:

2) What to build?

Building a kind of sailplane that is already in the market is not recommended. It is far less expensive to buy it ready-made, especially if it is second-hand. In Europe the old Ka-6es were easily available during the last decades. Many glass ships are already a good bargain, as they grow older.

In building a sailplane, you have to experiment with something that is not commercially interesting. In the seventies we experimented with a 12m span sailplane. In the nineties, such gliders were built as the World Class racers. There is no reason in building one more now. We also built and flew a sea-glider (the "Gliding fish") and we found out for ourselves why it is not worth the trouble.

Today there is a wide gap to fill by homebuilders. It is the gap between hang-gliding and soaring. The gap is attacked from below by the hang-gliding movement. Sailplane manufacturers have shown no interest to narrow the gap from above.

That is the target, but it is very wide indeed. Let's narrow it.

3) What will be the use of it?

What are the main advantages of hang- and para-gliders that made them so popular?

First, they are easy to stow. Well, we cannot match them there. You cannot build a sailplane that can be thrown in the trunk of a car, nor a sailplane that can be stowed in your closet and leave some room for your socks.

Second, they are light and easy to rig. We will do our best there.

Third, they do not have to take-off from airports and airfields. They are foot-launched from any slope. Now, that's a great advantage. If you like to do some mountain bike you do not pedal there from the city. You drive there with your car and spend the day with you bike on the mountain. Local flying is much more interesting than taking-off from a distant airport, leaving all your friends behind.

Foot launching capability is a utopia for gliders. Any foot-launched glider that has been built, made just a few foot-launches to prove compliance to some regulation. Then it was used with a bungee-chord or a tow-car. As a bungee operation is more demanding than car tows, let's consider bungee launches.

4) Slope launching

Slope launching means to have 8 or 16 slaves stretching long elastic ropes down-slope. That is… until you don't need them any more and leave the suckers behind you on the ground. Well, not necessary so.

We have seen a picture of a light primary, sliding from the top of a vertical cliff, using just a small slippery board (fig.64). That's the lower extreme in aircraft launching.

Given a strong catapult, you can launch practically anything. A Navy bomber heavily loaded with bombs is the upper practical limit.

It would be a pleasant dream to have a catapult incorporated under the trailer of your sailplane. As a simple alternative, the classic elastic rope can be stretched down slope by your car, using a reverse pulley.

64

For limited launching energy you need a sailplane with low weight and low stalling speed.

Given the weight of the ship, there are two ways to lower the stalling speed. First a high lift airfoil, witch is a must to all such sailplanes. Second a large wing area. But how large?

5) The wing area

There are reasons against a large wing area. Aerodynamically speaking, a large wing area with limited span reduces the aspect ratio of the wing. This doesn't do any good to the L/D (glide angle).

For a light glider that would be rigged on a slope, there is a more practical reason against large wings. A small gust could just blow a large area wing out of your hands. Many years ago, we where testing a light glider in a field, while the breeze was building up. The last fellow had the bad idea of stepping out of the ship after his flight, as we would have done in any ordinary sailplane. The light ship was just blown over.

For a gross weight of around 180 kg a wing loading of around 20 kg/m^2 gives a stall speed of around 45 km/h. This is too high for foot launching, but low enough for easy bungee launching. It gives a wing area of something less than 10 m^2. But how about the span?

6) Performance

A large span is good for performance. It is bad for anything else.

The structure becomes heavier, as the bending moment at the root increases and the spar height decreases. The tail becomes longer and the rudder larger, as the adverse yaw of the ailerons increases.

Longer wings and longer tail mean a longer trailer, a longer garage, and a longer workshop to build the glider in.

The whole problem becomes a compromise between performance and anything else.

There are many ways to decide the performance of a sailplane. For example, the performance of our sea-glider has been restricted by the length of the timber that we had for the spars. For the World Class glider an L/D better than 30 and a stalling speed less than 65 km/h were the defining figures.

The best L/D is the most published number. It was around 25 for the best trainers of the 60ies. It went up to 35 in the 80ies. For racing machines it goes as high as 50 and even more, always at the cost of higher stalling speed.

If you plan to stay in the area of lift, the maximum L/D is not the decisive factor. It is the minimum sink rate that matters. In local flights, a para-glider with an L/D of around 6 is as good as a super sailplane. In very narrow thermals it is even superior. The high L/D and the high speeds are needed only when you leave your lift and start flying through sink. Modern sailplanes are designed to deal with sink.

Enough exaggeration, L/D is good even for local flights, even for our noisy motorized brothers. We also must not forget that, for a given flying speed, better L/D means better rate of sink. What is the minimum acceptable value of L/D?

7) The best L/D

Para-gliders, hang-gliders, the space shuttle and any other poor performance glider, tend to have an L/D lower than 15. Above 15 you are in the sailplane domain and you need spoilers (or at least side-slips) to land on the runway.

With today's technology an L/D of 15 can be easily achieved. To attain an L/D of 30 on a small glider, you need an international design contest, as was the case of the World-Class racer. For a home built ultra-light glider, the range 20-25 is a good target. Do not forget that the Schweizer 1-26 (the best-seller US sailplane) had an L/D of only 21,5

Simple performance calculations can tell us that a 10-11 m span will do the job.

8) Existing sailplanes

You build an airplane around an engine and you build a sailplane around a wing. Once you chose your wing, everything else has to match. Before going any further though, let's search in the literature for existing similar sailplanes.

There are some expensive high-tech foot-launched ships like the Swift or the Archaeopteryx. They are sophisticated constructions, out of reach of home-builders.

Examining light sailplanes we find two distinct breeds.

First are the offsets of the World Class contest and the like. The polish PW5 and the Russian Mechta are good examples. They all aimed at good performances and they stall around 60-65 km/h. They are airport sailplanes, not intended for bungee launching. A buyer focust in performance would find in the market many old second-hand racers with far better performance, at a lower price. As most buyers assume that their back is strong enough to carry around heavy sailplane parts, old racers are preferred to any new light breed.

Second are the very slow UL sailplanes like the foot-launched ones. The American Carbon Dragon and the German ULF1 are good examples. They are two quite different flying machines. The Dragon with its huge surfaces is top performer (with an L/D of around 25 and the best rate of sink you can dream of). The ULF1 is far less performing but far easier to build. What they have in common is that they are not suitable for rough ground handling. They are "handle with care" ships. Their very low stalling speed makes them also vulnerable to gusts when on the ground.

What do we have in-between? Not much, you have to open the history books. Find the Ka1, or Ka3, or find professor Hütter's Hü-17 (it is also called Gö-5). There are still some of them flying today, as vintage gliders.

The feasibility of a modern in-between can be taken for granted. The operational mode is worth testing. How about starting the project?

9) Building materials

There are three main materials for building sailplanes: wood, aluminium and composites.

a) **Wood** is the friendliest. It can be easily worked with simple tools. It can be easily shaped and repaired. On the other hand, it has some major drawbacks.

First, it is difficult to choose wood from the shelf. If we test specimens cut from the same block, we end up with very scattered results.

Second, we cannot give to wood any shape we like. A plywood sheet can only be bent to a cylinder or a cone. An easy to build wooden fuselage tends to look like a wooden crate.

Third, the impact resistance of a wooden ship is not great. Wood tends to break without absorbing much energy by deformation.

Last, we cannot give to a wooden wing the tolerances needed for the ideal flow. The plywood tends to sag between ribs, giving an airfoil of uncertain shape.

b) **Aluminium** is a material with well-defined properties. It can also be worked with simple tools. The problem is the jigs. Jigs are used to shape aluminium sheets. They are used to align the pieces together. They are used to hold the pieces together before riveting. The jigs are in steel and they tend to have as much work as the sailplane itself.

To build a light sailplane, we need to work with very thin sheets of aluminium. In sailplanes the rivets have to be sunk, which is a lot of work with unsatisfactory surface result.

The shapes that we can obtain with aluminum sheets are the same as with plywood. This is the main reason why, many wood or aluminum built sailplanes have at least a composite built cabin fairing.

c) A fine looking fuselage is a **composite** fuselage, coming out of a mould. To obtain one composite fuselage, we have to build three: the plug, the mould and the final piece. The difficult part to build is the plug and not the flying final piece. Working with epoxy resin for the final product, is not very difficult, but it is a messy work, unrewarding and unhealthy.

Plug building has a huge amount of work, but is a highly rewarding procedure. A plug gives us absolute shape freedom.

A fiberglass shell is a heavy shell. On a UL sailplane we have to do your best to obtain the least outside surface allowed by structural analysis. The rest of the surface would better be formed by a stressed membrane of some kind. This is usually fabric, cotton or Dacron (polyester cloth).

Building a fuselage plug means we have to work on a surface of 5-8 m^2. This is small compared to the 20-24 m^2 needed for all the lifting surfaces (upper and lower surface of wings and elevator). This is the reason why, full composite wings do not always accompany a composite fuselage. Full composite wings are normally left to the professionals.

The choice of materials is often decided by previous experience. If you love wood (wood is worm and can be lovable) then you will have basic objections to all other materials.

If you have worked with aluminum (perhaps serving in the Air Force) you will consider other materials less reliable. "Aluminum is a material for true men".

If you enjoy giving shapes to things (a truly noble artistic occupation) you will build a plug. You would consider anything else a pour compromise. Working with the dirty, sticky juice, called epoxy resin, will have to follow. It is so unfriendly and unhealthy that you have to work wearing gloves.

Now, let's leave aside the "psychology of materials" and be more practical.

10) Pieces in fiberglass

If we decide that some part of the fuselage will be built in fiberglass, it means that we will have the know-how of the material. There is no reason not to extend the material to the whole fuselage. That means a surface of about 6 m^2 to be built in fiberglass.

The wing area is about 10 m^2 and the elevator area about 2 m^2. That means that an area of about 24 m^2 of skin has to be built in some material.

If we build our UL sailplane in wood or aluminium, we would never consider covering the whole skin with that material. We would probably think of about 50% fabric skin. Why not so in a composite UL sailplane?

If we keep a 50% of the chord in fiberglass, we can have a nice D torsion box and a nice laminar flow for the leading part of the wing. From the total 24 m^2 about 12 m^2 remain to be covered with fabric.

The plugs for the wing have to be very accurate. We need a lot of very accurate templates for the final finishing. The plugs and the moulds for such a wing are very large and very heavy. We can see them in pictures of professional sailplane manufactures. For a homebuilt glider you need a simpler way of building the fiberglass wings.

A wing can be built the simple way, if we have the central part of the wing in constant chord. We need a very accurate plug for the constant chord part of the wing. We can work on a very accurate plug (plus mould) for a wing section of about 1 m span. With this mould we can produce many wing sections and put them together for the constant chord part of the wing. We also need two additional plugs, each for every tapered wing tip. This is later explained in details in Part 5 of the book.

The total surface to work on, depends on the span of the wing tips. If the constant chord plug and the wing tip plugs are each about 1m span, we will have to work on a surface of about 3-4 m^2 only. If you like to do more work, just choose longer wing tips. That will also do much good to performance.

With this in mind, we can forget about wood and aluminium and use only composites. We would use composites where we need strength or laminar flow. We would use fabric for the rest of the skin. It looks like a strong, efficient and light choice.

11) Building plugs

We start by building the plugs and the moulds. After a huge amount of work, we would not have built a single flying part. We would have focused on shape. There is a major benefit to be considered: In this stage, none of our mistakes would have structural consequences.

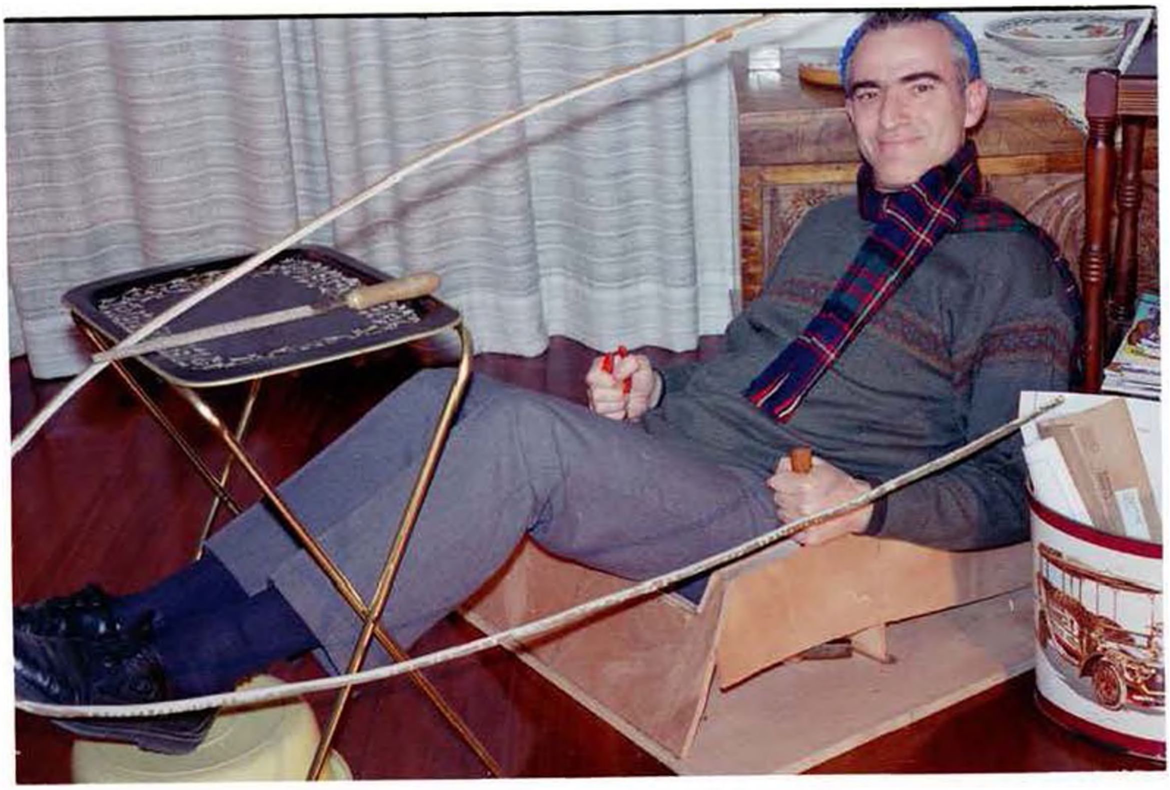
There is also the argument that the work for the moulds is well justified by the potential to build more than one sailplane. This is a midsummer night's dream, but it helps a lot in boosting the homebuilder's moral and determination.

12) The canopy

The canopy is a major problem in sailplanes. It has to be curved and optically clear. Do not ever think of blowing a canopy by your self. Even sailplane manufacturers avoid it. Most sailplane canopies are drawn on male moulds somewhere in Switzerland. They are very expensive.

When building the π12, we did not consider heating the canopy sheet to a temperature fit for 3D deformation. We just tried low temperature bending into a conical surface. The outcome was far less than satisfactory.

The frame of the canopy and the hinges are also delicate pieces. Matching the frame to the canopy



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and trimming the whole thing to fit the fuselage, is also a very fine work.

A frameless cone shaped canopy of thin Plexiglas would be ideal. Here though lies a safety problem. The canopy is not there only to shield us from the wind. It must also shield us from fence wires, when out-landing. If you have seen a two-seater landing in barbed wire, you would appreciate contemporary thick canopies.

According to some old Dutch sailplane building regulations, it was mandatory to have a protective steel tube between the canopy and the pilot. If you want to avoid a heavy, thick canopy with a robust frame, you would have to consider a structural member in front of the pilot. This member could divide the single canopy in two elliptic side canopies. In fig.[65] we test the positioning of such a elliptic canopy in relation to the pilot's seat.

13) Landing in rocky fields

Rocky fields may not be a problem in flat countries. It is more likely to arise in mountainous lands like the southern Balkans. Marginal out-landing fields may have hidden rocks. There are cultivated fields where the land is a mixture of fertile soil with stones. Even in flat cultivated land, you may find small outcrops of stones that the farmers gather while cultivating their fields.

Small damage to sailplanes during such landings is a calculated risk. When our DG-100 met a rock under the grass of a normal looking field, the cockpit shell was torn (on the seam under the rudder pedals), and was easily repaired. It is of major importance to install several protective layers between the stones and the base of the spinal chord of the pilot.

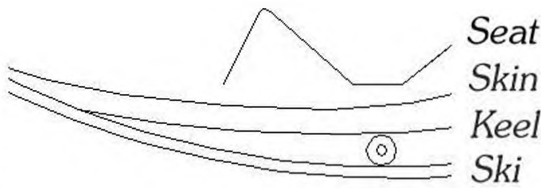
A sailplane which is built to operate on stony fields would better be landing on a ski and not on a wheel. A ski is a good protection against stones and gives some reassurance that the fuselage will climb over eventual rocky bumps.

A seat reinforced with some layers of kevlar cloth is an ultimate shield for the bottom of the pilot. Some more protective layers can be provided between the ski and the seat.

The fuselage shell will receive the impact of stones that will pass left or right of the ski. It is important to reinforce the lower part of the cockpit shell. It is also important to leave some space between the cockpit shell and the seat. Seating on the shell itself is not recommended.

In the past, most sailplanes landing on a ski had the ski mounted on the outer skin of the fuselage, through some shock-absorbing device (e.g. rubber blocks). This put the fuselage skin rather close to the ground. When the rubber blocks were compressed, a medium sized stone could easily reach the skin.

To lift the skin above the stones, a keel could be used between the fuselage and the ski. Zögling type primary gliders had a deep keel between the seat and the ski. A local story goes that new students repeatedly demolished the ski in rocky ground. As a result, the ski was discarded all together and an iron sheet was fixed on the keel itself. Shock absorption was gone. The strong keel held well and no more repairs were needed on the ski. We have no information on vertebrate repairs after unabsorbed landings.



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In a sailplane built to operate on rocky ground, a keel could be incorporated in the fuselage construction. In this way there will be 4 protective layers: the ski, the keel, the skin and the seat (fig.[66]).

14) The calculations

After deciding the general layout of our glider, we will have to proceed to aerodynamic and structural calculations. For these we will need some existing specifications. We may not follow the specifications strictly, but it is recommended that we know where we deviate from them.

Do not try to read the contemporary European specifications, such as the JAR-22 "Sailplanes and powered sailplanes". They are not written for engineers but for lawyers. I copy an example: *"The launching hook attachment must be designed to carry a limit load of 1.5 Qnom, as defined in JAR 22.5819b0, acting in the directions specified in JAR 22.581 and JAR 22.5830".* These rules were known as EASA-22 for awhile and now they are called CS-22. I did not follow the amendments of the rules. It is easier to build a glider then to deal with European rules. They remind me of Asterix and the Roman bureaucracy.

In the past, the specifications were written for technically minded people, not for lawyers. The old German specification "Lufttüchtigkeit für Segelflugzeuge - 1966" (in German language), or the FAA specification "Basic glider criteria - 1962" (in British units), contain concrete data for our calculations. Greek readers can find the most important of those data in the issue 48 of our "Aerosport" newsletter (June 2002). They also appear in attachment to my Greek book "Ερασιτεχνικές αεροκατασκευές" (amateur aircraft building – 2011). It is downloadable in .pdf format from the address www.aerodata.gr

We will also need materials specifications. Common materials (*"di uso comune" as they say in Italian*) are not sold according to very strict specifications. Even if we test a material in our workshop, a merchant could change his provider without notice.

After we chose the specifications of our glider and its building materials, we will go ahead with the calculations. They are the same as for motorized airplanes. They can be found in many books in any language and also in the Internet. I have seen nice books in English, German, French, Italian and Russian. French and German books dated before WW2 are very detailed in their analysis, even for double-deckers.

Today there are many computer programs to do the calculations for us. The problem is what they demand from us as an input. We do not proceed in very accurate calculations. A 2% accuracy is more than enough. The data we started with are approximate anyway.

Part 5 - Building the "πτiλον" (how)

In part 5 you will find a description of how I built the glider. This does not mean that I consider this to be the best way to solve the problems. It was just a way suitable to the materials available at the time, and to the skills acquired until then.

The only material that was exotic at the time was the carbon-epoxy pultrusions that were ordered from the US. The common wing struts came from France. All other materials were found in the local market. They were materials *"di uso comune"*. The market of Piraeus is very rich in boat-building materials. Special materials could also be found is the small industrial market of Athens.

Some readers of this book could be interested in commercially building flying machines. I would like to state that I am an amateur, without any professional involvement with aircraft. Building an aircraft professionally has nothing to do with what you are about to read in the following pages.

1) Building the skin of the stab

A well-known advice is that before everything else you have to build the stabilator, using the same material as in the wings. The stab is a small piece that you can throw away, if anything goes wrong.

The stab is symmetric right and left, as well as up and down. You have to build a mould only for the half of it. A plug can be produced today very easily on a CNC machine, if you provide it with a 3D drawing. The problem is its cost. A university lab might not have such a problem. For an individual homebuilder though, only 2D laser cutting was financially accessible.

The plug was built by carving a solid block made out of pieces of plywood glued together. A block of wood about 110 cm X 40 cm X 6 cm is not difficult to handle around in the workshop.

After much sanding and polishing of the plug, a two-piece mould was lied-up using common glass and polyester resin (fig.67). Polyester is much cheaper then epoxy resin. It is widely used in boat building. It is preferable to use polyester for the heavy moulds and leave the expensive epoxy for the light final pieces. The gel-coat for the mould is polyester based anyway. Polyester is not as harmful to health as epoxy is.

Once the mould was built, we could produce the first piece that would fly (fig.68). It was also for us the first attempt to use vacuum technology. The pieces to build were small and could be lifted with one hand, so we could use vacuum bags, as our friends the aeromodellers did. We put the mould with the laminate in a plastic bag and

67

68

69 

draw the air from within with a vacuum pump. A vacuum pump is not an expensive piece of machinery. It is just the motor of an old refrigerator.

Working with vacuum is not difficult if somebody tells you a few trick as for example "*les bandes d' arrachage*". You lay first the outer glass layer, than the foam, next the inner glass layer and last "*les bandes d' arrachage*". The recommended way is to draw vacuum after the first layer, then after the foam, then again after the inner layer. That is a lot of work. In small pieces, we put all the layers together then draw vacuum just once.

Excuse me for using terms in different languages. In our small group, once we read something in a foreign language we keep on using the original term, just for the fun of it (e.g. a Gummiseilhund cannot be anything else). This reminds me of the Swiss magazine "Aerorevue Suisse" where you could write in English, plus German, French, or Italian (the official languages of the republic) without any translation. The readers were supposed to understand all these languages. With today's digital translators you can read almost everything.

Once you have the two halves of the half-stab (top and bottom surface) you close the mould and join them by applying glass bands while still in the mould. In fig.[69] the stab skin is removed from the mould.

Next, you join the right and the left part of the stab and you insert the central reinforcements in places where the stab will be connected to the fuselage.

2) About the stab spar

Most homebuilders prepare the spar as a separate piece and incorporate it in the stab with a lot of putty. They do the same for the wing spar. So do most professionals as well. Our choice was to build the spar in the ready-made skin.

For the spar caps of the stab we used the same carbon pultrusions that we had for the wing spar. We first glued the spar-caps on each skin. Then we glued the spar web in-between the caps (fig.[70]) and connected everything with fine glass-cloth on the outside. The famous Interglass 92110 cloth could be found in Piraeus.

70 

We did not do any thermal curing of the epoxy. Our summers are very warm and the pieces have not been used for many years. So, they had all the time to cure.

Once you can produce a satisfactory stab, you will have no problems in working on the wings. We have been repeatedly approached by people dreaming of building sophisticated composite aircrafts. Our advice is: "Build a simple stab first, and then we will talk about the rest of the aircraft".

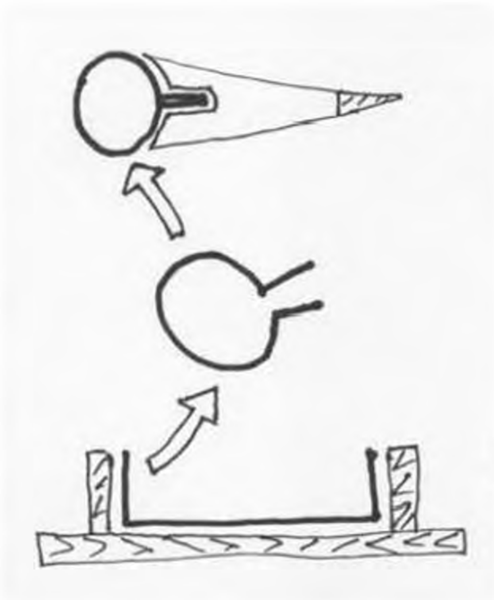
3) Building the elevator

In most aircrafts the elevator is actuated from its root. Its main load is torsion, which necessitates some kind of D-tube. In her "Hippie", Frau Hänle had a clever idea. She used a thin fiberglass tube with a shelf that was inserted in the ribs. We did not know how she formed the fiberglass tube, so we had to improvise.

We started by building an inverted Π in fiberglass, and applying vacuum. Some hours later and before the fiberglass would harden, we took the Π out of the mold and bended it around until its two vertical walls met (fig.71). They were pressed together and left to harden overnight. When the two walls were later glued together, we had a tube with a shelf where the ribs could be fixed.

This method of building the torsion tube produced a constant diameter tube. In consequence the spar of the stab had a constant height from the root to the tip. The airfoil of the elevator started as a NACA 0009(mod) at the root, but was much thicker then 9% at the tip. This is an aerodynamic disadvantage, but it also facilitates the alignment of the stab on a flat bench.

The flaperons were built in the same way (fig.72).



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72

3) Building the wings (front part)

A glider needs a high span wing. That means a heavy wing. In the old days, you could build a light wing by bracing it with wires. They had less weight but more drag. Very soon struts replaced the wires.

A strut could keep the wing rigid in bending but not in torsion. To resist torsion, two spars were needed with two struts (as in the Piper-Cub). In order to have a single strut, torsion had to be carried by a rigid shell somewhere in the wing. In some airplanes the rigid shell was a box-spar (as in the Jodel homebuilt airplane) and the skin had no structural purpose. Alternatively the rigid shell could be the skin of the wing. The result was the D leading shell.

The classic sailplane wing had a single strut and a D-shaped leading shell. This was built by very light ribs in the shape of the airfoil, and it was covered with a thin sheet of plywood. In order to keep the weight down you needed more ribs and thinner plywood. That was a lot of work.

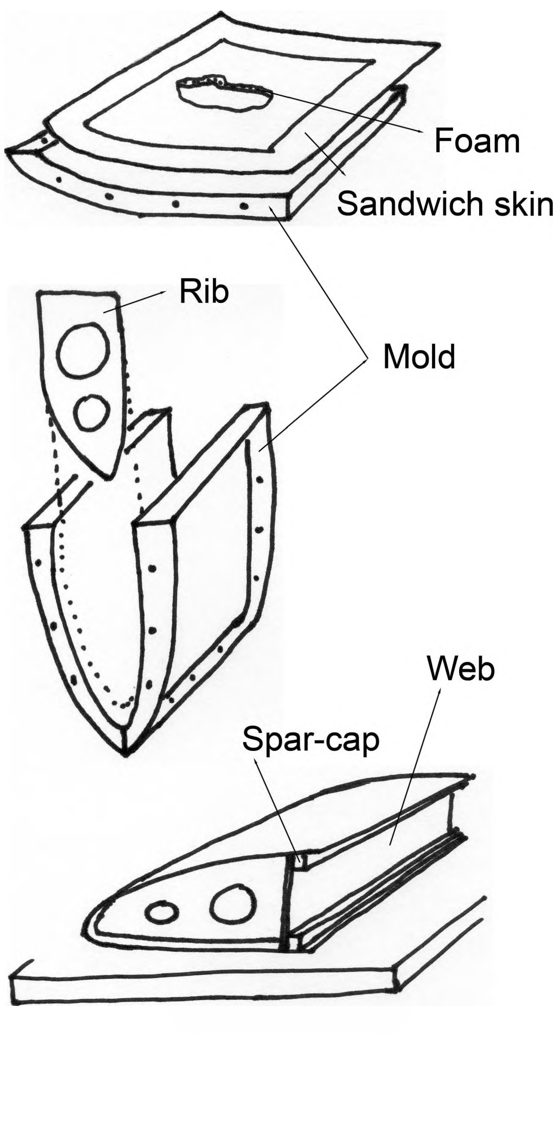
Today, aircraft homebuilders with traditional mentality are trying to use modern materials, without loosing the old way of doing things. They replace the wooden ribs with foam ribs and they still cover with plywood. In other attempts, they replace plywood with homebuilt fiberglass sheets, keeping the ribs of the inner structure in the traditional way. We have also seen a builder forming fiberglass ribs in moulds.

Contemporary wing building is achieved with sandwich skins. To build a sandwich you have to master the vacuum technology. Once you can draw vacuum, you can form any shape of sandwich skin consisting of fiberglass+foam+fiberglass. This skin does not need many ribs.

A professional wing is built on moulds as big as the wing itself. Those are very heavy fiberglass moulds, reinforced with steel frames. You handle them with a crane-bridge. They are not suitable for homebuilders.

In homebuilding you have to use smaller moulds. A constant-chord wing can be built in many sections, using the same mould again and again. For better aerodynamic results, two more moulds could be used to add tapered outer panels.

Small moulds have the advantage of not needing additional external frames for rigidity. They are also light enough to be lifted by hand and placed in a vacuum-bag. A vacuum-bag makes the vacuum-story much simpler.



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In building light wings you need a D-tube extending from the leading edge to the spar. The rest of the wing would be covered with fabric. Here arises a problem concerning the airfoil.

To build a small light D-tube you need an airfoil with the maximum thickness (the spar position) as front as possible. Old airfoils have the maximum thickness at around 30% of the chord.

Building a fiberglass wing in a mould, you have the possibility of building a laminar wing. Laminar airfoils have their maximum thickness at around 45-65% of the chord. This means more weight for the D-tube. The choice of the airfoil is not just a matter of aerodynamics.

The problem seems difficult, but there is one more consideration that makes things easier. Homebuilding is much simpler if the lower surface of the wing is flat. In this case, the wing can be assembled on a flat table, without the need of any jigs (fig.[73]). The fabric of the rear part of the wing can also be easily worked, without the extra care needed for a wing with under-camber.

There are not many flat airfoils. The venerable NACA 4415 is a flat-bottom turbulent airfoil, with the maximum thickness at 30% of the chord. It has been extensively tested and used in many low-speed

74

75

applications.

The later UAG88-143/20 is a flat-bottom laminar airfoil, with the maximum thickness at 44% of the chord (not too far from the leading edge). This airfoil was designed for the World-Class glider by D.J.Marsden, and it was first tested in Alberta. It has also been extensively tested by the Germans of Stuttgart, in order to prove that it was no better than the German airfoils. In a light glider we don't mind some slight performance discrepancies. This airfoil is a flapped airfoil (20% fleps), which gives us the advantage to be suitable for flaperon use.

Our choice was the UAG88 airfoil. Once you build a plug and a mould, you are bound to the airfoil for good.

The next decision to make was: How wide should each section be along the span of the wing?

If you have to reach the inside of the D, the length of your arm plus a brush is the limit. So we thought that each section would be something between 80 and 90 cm wide. Our plug was 84 cm wide. In consequence, the mould was 84 cm wide, and 50% along the chord.

As it came out, the way we built the wing was such that the 84 cm limit was not needed. A width of 1,2 m would have been better. A still wider mould would be too heavy, and its plug would have additional hard work.

After building the skin in the mould, a plywood rib was glassed in one side of the section while still in the mould. After removing it from the mould, each section was ready to receive the adjacent section on the flat table. Fiberglass bands were glassed in the inside to connect the two sections.

After connecting the sections, we had a piece of constant-chord D with a plywood rib every 84 cm. At the tip of the constant-chord sections we fixed and glassed the (1,25 span) tapered outer panels.

At this stage we had an open D with a few ribs (fig.74). All we had to do to close the open side of the D, was to fit the spar web (fig.75). After that, the front part of the wing was rigid and could be placed nose-down without deformation.

In this position, the spar could be easily built in the wing itself, without having to build a separate mould for the spar (fig.76 next page). Building the spar directly in the wing assured a perfect bonding of the spar-caps to the skin and the whole wing structure. We also saved the weight of exessive putty that is normally used to bond the spar to the shell. For spar-caps we used carbon pultrusions.

The spar was completed by adding vertical spacers between the caps and a second web where needed.

76

4) Building the wings (rear part)

The rear part of a wing with flaperons needs a C-shaped rear spar. This spar would carry no loads other than the tension of the fabric skin, and it can be built as light as possible. We built the rear spar in fiberglass using a small mould. The mould was made out of steel sheet bended in the exact form of the spar. The fiberglass was laid on the mould and put in the vacuum bag to cure overnight. Each spar was made out of three pieces joined together to the total length of the flaperon.

The next step was to place the D-tube and the rear spar on a flat table in their exact positions, in order to build the ribs in-between. The method that we used for the ribs was not the easiest way of doing things, nor was it the lightest.

We first built a flat sheet of fiberglass and cut it in ribbons. Then we glued the bottom ribbon between the D and the rear spar. Next we glued the rib cut out of 12 mm PVC foam. Last we glued the top ribbon (fig.77). All gluing was done with epoxy+microballoons putty.

In the root side of each wing a diagonal drag spar had to be built (fig.78). This was built with multiple layers of fiberglass extending to the main spar. At the root of the rear spar, multiple layers of fiberglass were also laid in order to receive the rear attachments of the wing.

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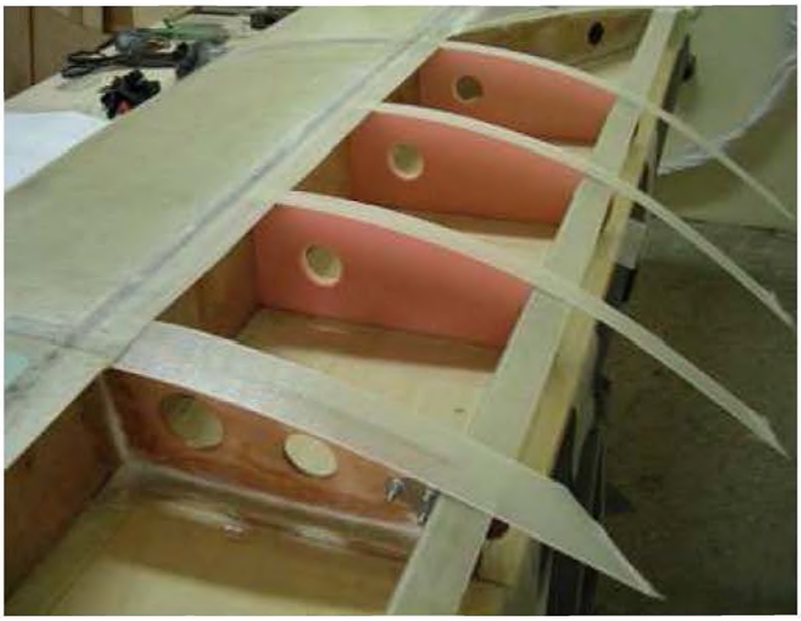

The space between the root rib, the main spar and the rear spar received more ribs, and was covered with a strong skin. This formed a rigid box that transfers the torsion from the wings to the fuselage.

Looking at the rear spar afterwards, we had following second thoughts: The distance between the two spars was about 30% of the root rib. The rigid part of the wing in front of the main spar was about 45% of the root rib. It would have been preferable to carry the torsion of the wing to the fuselage directly through the D-tube. In this way the diagonal drag spar could be omitted. The drag box is a lot of work and a lot of weight. In this case, the design of the fuselage would also have to be modified.

The flaperons were built the same way as the elevator: a torsion tube plus the ribs.

5) Static loading of the wing

Using sandbags is the textbooks way of loading a spar. The problem is where to find the sand, and what to do with half a ton of sand, after the test. In reality any load can do. We used some weight-lifting disks, plus many plastic water tanks (fig.[79]). Filling and emptying water tanks (fig.[80]) is much easier than dealing with solid loads or sand.

The procedure was to support the spar with a jack. Next to load the spar. Last to lower the jack gently, until the spar was fully loaded.

The stress analysis calculations of the wing have been done for a normal category sailplane. That means a limit load of 5,3 g and an ultimate load of 7,5 g.

During the static loading we imposed a weight of 5,3 g. That means that the actual limit load of the glider is 4 g. This is more than enough for an UL-glider.

6) Static loading of the stab

Static loading of the stab can be done on a bench, but preferably on the tail of the finished fuselage. In this way the attachments of the stab are also tested (fig.[81]).

79

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7) Building the fuselage

There is no difficulty in building a fuselage. No sandwich is needed anywhere. Compared to other pieces built, it is a work needing more than one person. Cutting and applying the successive layers of cloth is a work for at least four hands, but it is not much different than in boatbuilding (fig.82). In this photo we have finished layering the right side of the fuselage and are applying the famous *"bandes d'arrachage"*.

When working with epoxy, wearing gloves is a must. Good ventilation of the workshop is also a must. Applying epoxy resin in cloth demands much more work than applying polyester for boatbuilding. In boatbuilding the glass to resin ratio tends to be from 40/60 to 50/50. In aircraft parts the ratio has to be 60/40 (more glass then resin). You do not pour resin until the glass is wet, like we do in boatbuilding. You pour a small amount of resin and work on it with a squeezy (rubber spatula) until it is well distributed in the cloth. That demands a lot of work.

8) Changing the building mentality

The traditional way of building an aircraft was to start from a structural skeleton. On this skeleton additional pieces were fixed until the outer skin of the aircraft was completed. Building was proceeding from the inside to the outside of the aircraft.

There are people who think that by substituting some of these pieces with equivalent pieces of fiberglass, they have a composite aircraft. A composite aircraft is something much different.

The contemporary way of building an aircraft is to start from a very accurate skin (fig.83) and to proceed to the inner components. Building proceeds from the outside to the inside of the aircraft.

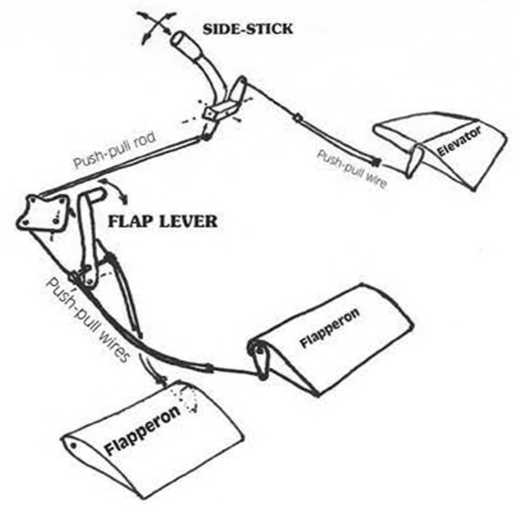
This is a whole new building mentality, not just new building materials.

9) The shape of the fuselage

Yes, you build an airplane around an engine and a glider around a wing, but a dream is built around a fuselage. The shape of the fuselage is left to the dreams of the homebuilder.

A pointed nose is more appealing to ultrasonic minded pilots. An egg-shaped nose has more room for your feet and allows a shorter fuselage. A parabolic nose has less drag. There are also designers who just copy the leading edge of their airfoil.

The percentage of the fuselage drag to the total drag is low, so aesthetics can prevail. There is just one constrain. In order to build light, you have to minimize the outer surface of the fuselage.



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84

10) The controls

Having full span ailerons, there is the possibility to use dual purpose surfaces, as ailerons and as flaps at the same time (flaperons).

Our flaps are camber-changing flaps with small deflections, not landing flaps with large deflections. For the landing of UL-gliders (with an L/D less than 20) sideslipping is recommended. Sideslipping is very pleasant to the flyer, as well as to the viewer.

For such a simple glider, flaps are an exaggeration, an experiment. Once you have the opportunity to experiment without extra cost, you try your best. The cabin of the glider was wide enough to accommodate a side-stick on the right side, and a flap level on the left side (fig.[84]). The problem was how to interconnect the controls to the flaperons.

Using push-pull wires made things easier (fig.[85]). Two parallel wires went from the stick to the elevator, just for safety. The ailerons control passed from the stick on the right side of the seat to the flaperon-mixer on the left side of the seat.

Part 6 – The workshops

After so many years of involvement in the sports of the air, I come to the conclusion that building aircrafts for fun is a very complex occupation. It is not just about building aircrafts and flying them.

The social aspect of amateur building cannot be overstated. Workshops tend to be meeting places for people interested in flight: people who like to build, people who like to fly, people who like to see, or people who just like to talk about flying.

- There are people who enjoy being on a flying machine and looking at the world below. There are also people who enjoy being on the ground and looking at flying machines up above, as the aeromodellers do.
- There are people with technical interest in flying machines. There are also people with aesthetic interest in flying machines.
- There are people interested in modern aircrafts. There are also people interested in vintage aircrafts.
- There are people interested in useful aircrafts. There are also people interested in useless aircrafts.
- There are people interested in feasible projects. There are also people interested in projects beyond their abilities.

All these different kinds of people meet in homebuilder workshops. They are quite different indeed.

A newcomer seams to be interested in all aspects of flight, without specialisation. It is only later that you can understand the real interest of each person present in the workshop. The more a person is active in the group, the more his interests differentiate. Clubs tend to be more uniform. In a gliding club you meet mainly sailplane pilots. In a modelling club you meet aeromodellers. In a workshop you meet any kind of people. I remember in Platon's workshop two friends arguing vividly if the propeller pitch mechanism of a certain German fighter of WW2 was electric or hydraulic.

The field of flight is so vast that no two persons share exactly the same dream. Even in the small field of homebuilt aircrafts, sharing dreams is very rare. What is to be built, and why is it to be built, differs widely from person to person. If they will still have the same dream tomorrow, is uncertain. If they will ever start building, is questionable. If they will keep on building after they start, is doubtful. Yet, all those people speak about aircraft homebuilding in a workshop, with the same vivid interest.

Not all workshops are suitable as meeting places. In order for a workshop to develop into a meeting place, the owner of the workshop must spend many hours in his workshop. This does not mean he has to have fixed hours, as it could be in a club. I have three examples of such meeting places:

a) The workshop of Platon

Platon Kourouvakalis was working in his workshop all morning and all evening. You just had to pass by and see if he was there. He was there most of the time. The workshop was a meeting place for some decades, until Platon was involved in training paragliding pilots. Then, Platon was most of the time on the mountain slopes. He was not often in his workshop which was no more suitable as a meeting place.

b) The Sevastos workshop

Georges Sevastos was an architect working all day long in his office. He was not in the workshop during the day. We knew that after the office he came to his workshop where he stayed for some hours. The workshop was a meeting place for aeromodellers building models (today most aeromodellers just buy their models ready-made). He and his friends were designing their own models. They were experimenting with exotic materials that they brought from different exhibitions of central Europe. Sevastos was also expert in the "Autocad" software and its latest versions. So the Sevastos workshop was a meeting place for many technically minded people.

c) The Kalogerakos workshop

Pantelis Kalogerakos is a MD. He was always interested in any aircraft building activity. He has been president of the "Athens Aeromodeling Club" for many years. He founded the "Aeroclub of Piraeus" where he was editing the local "Sport Aviation" magazine. Then he founded the "Experimental Aircraft Club" where he was editing the local "Airplane" magazine.

In all those years, Kalogerakos kept some workshop where he was always building something in wood. He did not have standard hours that he was in the workshop. We just called him and learned when he would be there. His workshop was a meeting place for people interested in homebuilt aircrafts. He had a large collection of drawings, books and magazines. He was able to find for you a certain photo in any of his magazines. He just opened one of his boxes, took out the issue and found the page, as simple as that. In the days before the Internet, such ability was of great value.

He has inspired many airplane homebuilders in Greece, either directly by giving them drawings, or indirectly through articles in the magazines he edited.

In all these three cases, the owner of the workshop was available as the centre of a rather loose group of people who shared some interest in flight.

Flying a small aircraft is a personal matter. A glider cannot operate without teamwork. Building an aircraft can be either personal or teamwork. Unfortunately, it can also evolve into just another babbling social gathering, with a lot of talking and little work. There are people who are involved in anything,

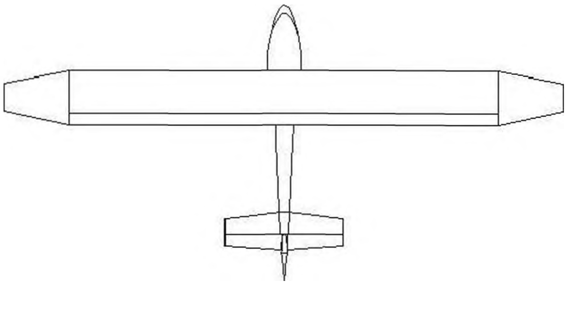
86

just to keep the talking going. Workshops tend to be a mixture of building and socialising. It is the owner of the workshop who keeps the fine balance of the group. He doesn't keep just the key of the workshop.

The photo above (fig.[86]) was shot in 2002 in the Kalogerakos workshop. Four friends are depicted. The third is A.Avdis, the second P.Kalogerakos, the forth C.Pikros and the first V.Katiniotis. Their age differences are 11-12-13 years. They had their first glider flight respectively in the 30ies, 40ies, 60ies, and 70ies. They hold a wooden rib of the Zögling pre-war glider. On the bench is the wing of the "Kiki" with foam ribs. Behind it is a sample of the "πτίλον" wing, build with vacuum technology.

In the years before the war, most youngsters intending to fly gliders were first introduced in building or repairing the gliders. Today, many videos appear in the Internet showing homebuilt aircrafts. If you look closely at the videos, you will notice that most people involved are aged people, not youngsters anymore. Homebuilding tends to be a hobby for retired flyers.

Today's flyers will be retired tomorrow. So they'd better acquire today homebuilding skills, and dreams (fig.[87]) to be fulfilled in the future.



87

Attachment A

Gliders and sailplanes

The difference between gliders and sailplanes is not just technical. It is not just a problem of performance. It is also a linguistic problem. Some languages use different words for those flying machines. Others don't.

In the issues 92 and 93 of our "Aerosport" magazine we had two articles on this problem.

Gliders and sailplanes (from issue 92)

Gliding as a youth organization and as a sport originated in Germany. So we have to begin with the German language.

German

A Flug/zeug (airplane) is literally a "flying/machine".

In German there are two words for a motorless flying machine. A "Gleitflugzeug" is a flying machine that glides from the top of a hill to the flatland below. A "Segelflugzeug" is a motorless flying machine that is able to sail in the atmospheric updraughts (Segel is the sail).

The German term for the sport is "Segelflug" (flight with sails). It is as simple as that.

English

The British followed the German tradition and also used two different terms. A "glider" was a term for the low-performance motorless aircraft, during the first phase of the evolution of the sport. Today a "glider" tends to be described as an "ultralight glider". A "sailplane" is the term mostly used for the contemporary higher-performance motorless flying machines.

In most English-speaking countries, the term for the sport is "gliding". In the US the sport is best known as "soaring".

Around the world there exist gliders (motorless flyers) with a motor. Their name is motor-gliders (motorless aircrafts with a motor !).

French

In France the term "Gleitflugzeug" (glider) was translated to "planeur". The term prevailed for all motorless flying machines (gliders and sailplanes).

Although the "sail" has not appeared in the French name of the machines, it appears in the name of the sport. The sport is named "vol à voile" which means flying with sails.

As for the sportsman, he is called a "velivole".

Italian

The term "aliante" is used for the gliders.

The term "velivolo" is used for the "aircraft". It has nothing to do with the French term for the glider sportsman.

The word aliante is produced by the word "ala" which means a "wing".

Spanish

The term "planeador" is used in most Spanish speaking countries for the flying machine, as well as for the sportsman. The common term is an abbreviation for "gliding aircraft" and "gliding pilot".

Many years ago, photos of a gliding camp appeared in the US "Soaring" magazine. A big sign in the entrance of the camp was stating: "Los planeadores son amicos de tristesa". We may be lonely flyers but, quite the contrary, we think that we are "amicos de alegria".

After the western European languages, here is a brief look at the eastern European group.

Russian

Russia and France have always had close intellectual relations, even though Napoleon reached Moscow and the Cossacks reached Paris. Ничего.

The Russian word "планер" (planer) must be coming from the French "planeur". There is no connection with the words "самолет" (samaliot) which is used for the airplane, or "Верталет" (vertaliot) the helicopter.

Polish

The Poles use the word "szybowiec" for the gliders. It was the first word of the Polish glider factory SZD (Szybowcowym Zakładzie Doświadczalnym). I have never tried to pronounce it, even when I have been in the factory of Bielsko Biała for a whole week.

Czech

In the Czech language there are two words for the glider. As in German, kluzák is the Gleitflugzeug coming from the word klouzání that denotes a glide. As for the Segelflugzeug, it is called větroň coming from the word vítr that denotes the wind.

The glider-pilot is plachtař and the word for gliding is plachtařství. Both words share the root plachta that is a cover (fabric or plastic).

Southern Slavs (Yugoslavs)

Serbians and Croatians share a common language "srpski-hrvatski". The main difference is in the characters they use when writing. Serbians use the Cyrillic alphabet, Croatian use the Latin alphabet. It is very easily pronounced (just keep in mind that č is pronounced ts).

The common word for glider is једрилица / jedrilіča.

The main sporting centre around Beograd has been Vrsač and it is also easily pronounced if you stress the "r" as being a vowel. нема проблема / nema problema.

Until now we have mentioned languages of the Indo-European language group. Let's turn to other languages, still written in some alphabet.

Turkish

Turkish belongs to the Altai group of languages together with Mongolian. It is written in Latin characters.

In Turkish the French word "planeur" is used as "planör".

Hungarian

Hungarian belongs to the Ural group of languages together with Finnish and Estonian.

Many decades ago a Hungarian glider-pilot sent me a Hungarian book, so that I could see its very nice drawings. It was called "vitorlázó repülőgép". I was always puzzled on how this term was pronounced. Recently a Greek team went to fly in Hungary for the international gliding contest. I demanded as a favour that they learn how to pronounce this word, just for my pleasure. When they came back a month later, nobody had acquired the ability. Fortunately there are now Internet sites that can speak the words you are writing in any language. That solved my problem.

At last let's come to Greek, which of course is an Indo-European language.

Greek

In the early '30ies the first glider arrived in Greece from Germany. The first gliders were ΟΛΙΣΘΗΤΗΡΕΣ (gliders). Later on, the term "Segelflugzeug" had to be translated. But in our maritime country the sails were not to be mixed with flying. The term for the sailplane is today ΑΝΕΜΟΠΤΕΡΟ (anemoptero). ANEMO is the wind and ΠΤΕΡΟ (ptero) is the wing (as in the common words pterodactyl and archaeopteryx). The first sailplanes where using the wind that produced lift along the slopes of the hills, and that justifies ANEMO. As for the ΠΤΕΡΟ it is nearer to the Italian ala-aliante.

There is also another possibility. In Modern Greek ΠΤΕΡΟ is the wing, but it is also the feather. ΠΤΕΡΟ ΣΤΟΝ ΑΝΕΜΟ means "a feather in the wind", a very common expression in the '30ies. The ΑΝΕΜΟΠΤΕΡΟ, as people where seeing it from the ground, was really a "feather in the wind".

In Greek the term for "glider pilot" is ΑΝΕΜΟΠΟΡΟΣ (anemoporos) the meaning being "somebody who travels with the wind". So "gliding" becomes ΑΝΕΜΟΠΟΡΙΑ (anemoporia) that means "traveling with the wind".

The word "sail" of most other languages gave its place to the word "wind" in Greek. As a consequence we are frequently asked: "How do you fly when there is no wind?"

Today neither the sail nor the wind are essential to the sport of gliding.

Among the languages, German, English, Czech and Greek use two different words. They make a difference between the gliders and the sailplanes.

Gliders and sailplanes (from issue 93)

A friend who has been active in gliding during the years of greater Yugoslavia gave us more information on the gliding terms in the Southern-Slav language.

As we have already written in our last issue, the word for the sailplane was "jedriliča" in both Serbian and Croatian. This word was used as "jadriliča" in the NW and as "edriliča" (едрилица) in the SE of Yugoslavia.

There was though another word for the primary gliders. This was "klizač" in Serbo-Croatian. It was used as "lizgač" (лизгач) in the SE.

So the ex-Yugoslavian dialects are among the languages that use two different words for gliders and sailplanes.

In the Bulgarian language the sailplane is known as "bezmotorni samoleti" (безмоторни самолети), a motorless airplane. The word "planeri" (планери) is also used.

The words denote Russian origin.

A friend from the Nederlands informed us about the Dutch term for the gliders. It is "Zweefvliegtuig" and it means a gliding airplane (Vliegtuig is the airplane).

The sport is called "Zweefvliegen" and this is also the verb denoting the act of gliding.

We also had some information on the Japanese terms.

As we do not have Japanese characters installed in our computer, we could not use the translator. A friend wrote these two words and we printed them here as images.

飛行機

グライダー

The first word is in Kanji writing and is pronounced "hikoki". It is the glider. The second word is in Katakana writing and is pronounced "guraida". It is the Japanese pronunciation of the English word "glider".

For the three last languages the information was not given by glider sportsmen. Our informers were speakers of the languages without any connection to gliding. As a consequence we cannot be sure about the existence of different words for gliders or sailplanes.

Any help in our search would be appreciated. We hope that the IGC in English (or traditionally the CIVV in French, *Commission Internationale de Vol à Voile*) will be interested in this multilingual gliding puzzle. They are officially connected to all gliding organizations around the world and could obtain the official answers.

You may wonder, what is the use of this linguistic drill? If you are interested in gliders around the world, these words could be very useful. Just write the appropriate word on your computer and let the internet find for you all photos and videos of the gliders for a certain country.

Attachment B

Future UL projects

Gliders that would fly in mountainous countries do not have a take-off problem. Most sites where paragliders operate could be used with some kind of catapult, or just by rolling downhill. The problem is not taking-off but landing.

The trend in today's sailplanes is to focus on the high speed domain. As for out-landing, they tend to avoid the problem by installing engines able to bring the sailplanes back to large airports. We do not expect new ideas on out-landings from racing sailplanes. The field is left to UL gliders.

In order to land in a small field as paragliders do, a glider must be able to stop quickly. That means to have a small touch-down speed and a small inertia after touch-down. The small inertia depends on the mass of the glider and that is a primary aim for every ultra-light glider. The landing mass of the glider is limited by the mass of the pilot. Given the small empty weight of today's ultra-lights, it would be beneficial if pilots were more vigilant of how much they eat. We can not do much in this field.

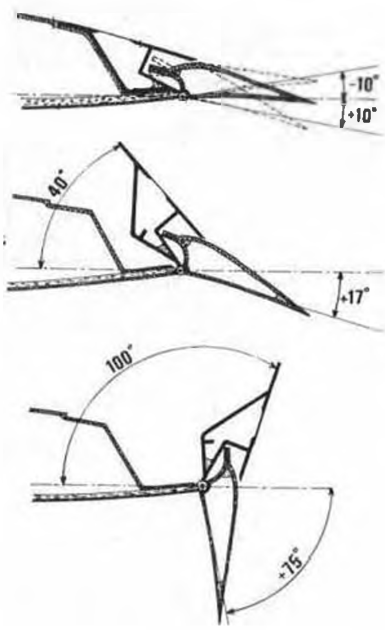
What we can do is to limit the landing speed. There are other aircrafts having the same problem: the airliners. In order to limit their landing speed they use a variety of high lift devices. They produce much lift and much drag. But stopping is only part of the problem.

In order to land in a small field as paragliders do, a glider must be able to spot-land. That means it must be able to approach the field with a very low L/D. Spoilers could be used as well as flaps which produce much drag and much lift. A combination of spoilers and flaps is recommended. This is what airliners use for landing.

High lift devices produce much lift but they also have a high nose-down moment. This imposes a very long tail. A clever combination of flaps and spoilers is needed.

This idea is not new. It has already been used in the wings of the "Glassflügel Mosquito", the "Mini Nimbus" and the "Slingsby Vega". They all shared the same wing design (fig.[88]). The wing of the Mosquito was heavy. It also needed a very complex mechanism in the fuselage which was also heavy. Aerodynamically though the design was very efficient. No other sailplane had such a steep approach. You could come about 100m high above the threshold, open flaps and spoilers, and zoom to a safe landing below.

Could a similar wing be built very light on an 80 kg glider? This is a real challenge.



88

The above thoughts propose an experiment to homebuilders who are operating in mountainous countries, and dream of slope launching operation. For sailplane pilots who operate from airports or flat airfields those arguments are pointless. UL gliders are not needed in airfields operation. Normal gliders evolved during many decades having in mind this kind of flying. For flatlands UL gliding is just a novelty, a fashion, or a competition class.

When operating from an airfield, the main problem of any glider is the initial climb. The answer is the electric motor. The noisy, oily, vibrating combustion engine is not suitable for our noble flying machines. An UL glider has just the advantage of needing a smaller motor.

Commercial sailplane builders have shown us some very interesting electric motor-gliders, even with folding nose-propellers. The problem is not in aerodynamics, nor in propellers, not even in electric motors. The problem is in the batteries, and there is nothing that aircraft builders, amateurs or professionals, can do to solve it.

The flat-landers will just have to wait. A reliable 80 kg motor-glider is not around the corner yet.

Attachment C

On polyester moulds

Friendly boatbuilders have told us many tales against accurate polyester moulds.

To begin with, they claim that such moulds tend to shrink and to deform slightly. This may be true for low glass content laminates. It is also true if all layers are laid on the plug at the same time. A thick mass of polyester laminate has the tendency to overheat, with sad consequences.

When working with polyester, just do not rush to finish the mould in a short time. Our fuselage plug has stayed inside its long mould. We can not find any shrinkage at all.

Another tale we have heard is that the reinforcement channels on the outside of the mould would induce marked deformations on the inside of the mould. If the mould is thick enough and is left long enough to cure, no marks appear on the inner surface of the mould when the channels are added.

Attachment D

Some more information on the photos

This book contains only the figures required by the text. In the digital era though there are hundreds of photos available. There are photos focusing on persons and photos focusing on technical details. We just made a selection of pictures explaining the text, not *vice versa.*

Foreigners reading this book had probably had enough Greek names included in the text. Greek readers though would like to know the name of each person depicted. In this attachment you can find more information on the photos and the names of the persons, in Greek. We also state the photographer who holds the negative of each photo shot on film, or the uncropped digital original of the photo. All photos have been cropped and downsized.

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[1] Φωτογραφία από ρωσικό blog περί εκτοξεύσεως ελαφρών ανεμοπτέρων.

[2] Το κλασσικό προπολεμικό ξύλινο ανεμόπτερο Zögling Stamer.

[3] Το Zögling με ουρά από τέσσερεις σωλήνες. Ο Αυδής το ονόμαζε αγγλικού τύπου. Τα σχέδια που κυκλοφόρησε η Βασιλική Αερολέσχη το 1937 ήταν για αυτόν τον τύπο.

[4] Κατασκευή ανεμοπτέρου Zögling στην Ανεμολέσχη Παλαιού Φαλήρου. Πρόκειται για τυπωμένη φωτογραφία από το αρχείο Αυδή.

[5] Ομοίως. Οι εικονιζόμενοι είναι σήμερα άγνωστοι. Αρχείο Αυδή.

[6] Πολύ μικρή τυπωμένη φωτογραφία προσκόπων που εργάζονται σε πτέρυγα Zögling, στην Θεσσαλονίκη.

[7] Το «γλαράκι» ήταν ένα προπολεμικό Zögling που επισκευάστηκε μετά τον πόλεμο. Φωτ. άγνωστος.

[8] Το σχέδιο του «γλάρου» όπως μελετήθηκε κατά την διάρκεια της κατοχής από τον Γεώργιο Πέσκε.

[9] Ο «γλάρος» αντικατέστησε το «γλαράκι» στις πλαγιές στο Μενίδι και στα Λιόσα. Οι φωτογραφίες των ετών '40 και '50 είναι λίγες και βρίσκονται οι ίδιες σε πολλά αρχεία.

[10] Μια από τις φωτογραφίες παραδόσεως του Zögling 2/3 από τον Αυδή στα ανάκτορα Τατοίου. Αρχείο Αυδή.

[11] Ο διάδοχος Κωνσταντίνος την δεκαετία του '60 στην Βασιλική Αερολέσχη, εμπρός από την φωτογραφία του με το Zögling 2/3. Φωτ. άγνωστος.

[12] Ανεμόπτερο Čavka στο «Αεραθλητικό Κέντρο Τριπόλεως». Φωτ. άγνωστος.

[13] Το Roda στην Έδεσσα με τους εκπαιδευτές Αχιλλέα Αμπάζη και Ιωσήφ Σινιόσογλου. Φωτ. Κ. Πικρός.

[14] Το Čavka εκτοξευόμενο στην Εδεσσα. Φωτ. Κ.Πικρός.

[15] Μοντέλο απλής μονοθέσιας ατράκτου υδρανεμοπτέρου.

[16] Στο σχεδιαστήριο οι Π.Κουρουβακάλης και Κ.Πικρός μελετάν το «ανεμόψαρο».

[17] Η πτέρυξ του «ανεμόψαρου» με τους Π.Κουρουβακάλη, Π.Καλογεράκο και Ι.Κωνσταντακάτο. Φωτ. Κ.Πικρός.

[18] Σχέδιο τριών όψεων του «ανεμόψαρου» από τον Πλάτωνα Κουρουβακάλη.

[19] Η πρώτη πτήση του «ανεμόψαρου». Σε πρώτο πλάνο ο Κ.Πικρός. Φωτογραφίζει ο Ι.Πιπιτσούλης.

[20] «Το ανεμόψαρο» στην ακτή Παρασκευά με τον Ι.Πιπιτσούλη που μας ρυμουλκούσε με το σκάφος του. Στο βάθος η μαρίνα Ζεάς. Φωτ. Άγνωστος.

[21] Το «ανεμόψαρο» στον Φαληρικό όρμο με χειριστή τον Κουρουβακάλη και άγνωστο επιβάτη. Οι πλωτήρες έχουν ήδη εγκατασταθεί. Στο βάθος ο Βασιλικός Ναυτικός Όμιλος. Φωτ. άγνωστος.

[22] Το ανεμόπτερο π12.

[23] Σχεδιαστικά όνειρα γύρω από το π12.

[24] Το μοδέλο του π12 υπό κατασκευήν. Φωτ. Κ.Πικρος.

[25] Το μοδέλο της ατράκτου έτοιμο. Το μικρό τμήμα πτέρυγας χρησιμοποιήθηκε για την σωστή διαμόρφωση της ατράκτου. Φωτ. Κ.Πικρός.

[26] Κατασκευή του κεντρικού τμήματος της τριμερούς πτέρυγας του π12. Φωτ. Κ.Πικρος.

[27] Το πολυεστερικό καλούπι της ατράκτου. Φωτ. Κ.Πικρός.

[28] Το εποξικό κέλυφος της ατράκτου έχει μόλις βγει από το καλούπι. Τα πράσινα φιλμ που κρέμονται είναι το αποκολλητικό στρώμα. Πίσω από την άτρακτο είναι ο Κλωντ Φρίντμαν. Εμπρός του βρίσκονται ο Φοίβος και ο Λέων Πικρός. Φωτ. Κ.Πικρός.

[29] Ο Κλωντ Φρίντμαν δουλεύει στο πλαίσιο της καλύπτρας. Η διαφανής καλύπτρα φαίνεται στην φωτογραφία ικανοποιητική, είχε όμως κάποια απαράδεκτα καρούμπαλα. Φωτ. Κ.Πικρός.

[30] Ο Γεώργιος Παγκάκης περί το 1939, ετοιμάζεται να εκτοξευθεί με ανεμόπτερο Grüne Post. Λοιποί εικονιζόμενοι άγνωστοι. Φωτ. άγνωστος.

[31] Ένα μοντέλο του Horten-229 υπό κλίμακα 1/1. Φωτ. κατεβασμένη από το ιντερνέτ.

[32] Το κύριο τμήμα της ατράκτου του Zögling κατεβαίνει από το πατάρι όπου ήταν αποθηκευμένο. Εικονίζονται: Κ.Μέλλιος, Χρ.Αλιγιάννης, Κ.Πικρός, Ν.Ραβάνης. Φωτ. Β.Κατηνιώτης.

[33] Ανεμόπτερο προετοιμάζεται για εκτόξευση με λάστιχο στο Rigi. Έχει ανεβεί με ειδικό βαγόνι του οδοντωτού σιδηροδρόμου που κάνει τακτικά δρομολόγια από την κοιλάδα.

[34] Η εκτόξευση του ανεμοπτέρου την στιγμή που το εγκαταλείπουν τα λάστιχα εκτοξεύσεως. Φωτ. Κ.Πικρός.

[35] Οι Α.Αυδής και Κ.Πικρός στην αυλή του πρώτου, γύρω από την άτρακτο του Zögling. Φωτ. Β.Κατηνιώτης.

[36] Οι Ν.Ραβάνης και Π.Καλογεράκος με την πτέρυγα του Zögling. Φωτ. Β.Κατηνιώτης.

[37] Ο Π.Κουρουβακάλης καθισμένος στο Hippie συνομιλεί με τον Κ.Πικρό. Τα χρώματα της φωτογραφίας είναι αλλοιωμένα προς το κόκκινο, η άτρακτος ήταν κίτρινη. Φωτ. άγνωστος.

[38] Η άτρακτος του Hippie μένει προς αποθήκευσιν στο Δεμίρι (Τρίπολη). Αριστερά Π.Καλογεράκος. Δεξιά ο Τριπολιτσιώτης κατασκευαστής Δημ.Καταλυματίας. Φωτ. Κ.Πικρός.

[39] Οι πτέρυγες του Hippie φορτωμένες για μεταφορά στην Αθήνα. Φωτ. Κ.Πικρός.

[40] Ο Β. Κατηνιώτης στην Σπάρτη, διασώζων τις πτέρυγες του Hippie. Φωτ. Κ.Πικρός.

[41] Μέσα στο μικρό αερομοντελιστικό συνεργείο μπορούσε να δουλέψει κανείς μόνο την μισή πτέρυγα κάθε φορά. Φωτ. Β.Κατηνιώτης.

[42] Κάποιες ευθυγραμμίσεις έγιναν μέσα στο σαλόνι. Φωτ. Β.Κατηνιώτης.

[43] Κατασκευή του Sourissette. Εικονίζονται οι Β.Αλεξόπουλος, Κ.Πικρός, Π.Καλογεράκος. Η λήψη δεν είναι στον Πειραιά, αλλά στην Κηφισιά, στο συνεργείο του Μ.Πουλικάκου, σε μια από τις μετοικήσεις του Sourissette. Φωτ. Κ.Πικρός.

[44] Τεμάχια του «Κικι» κατασκευάζονται στον Πειραιά. Εικονίζονται οι Π.Καλογεράκος και Β.Αλεξόπουλος. Φωτ. Κ.Πικρός.

[45] Ο Π.Καλογεράκος με το «Κικι» στο νέο εργαστήριο του στον Πειραιά. Φωτ. Β.Κατηνιώτης.

[46] Το σκι του «Κικι». Εικονίζονται οι Β.Κατηνιώτης και Π.Καλογεράκος. Φωτ Β.Κατηνιώτης.

[47] Ο εφετήρας του «Κικι» με δυνατότητα μετατροπής για ρυμούλκηση ή για λάστιχο. Φωτ. Β.Κατηνιώτης.

[48] Ο Β.Κατηνιώτης μετράει με καντάρι πόσο περίπου βάρος πρέπει ακόμα να προστεθεί στο ρύγχος, για να ισορροπήσει το ανεμόπτερο πάνω σε ένα ξυλάκι τοποθετημένο στο ΚΒ. Μέσα στο ανεμόπτερο ο Π.Καλογεράκος. Φωτ. Β.Κατηνιώτης.

[49] Το «Κικι» στην Κωπαΐδα. Φωτ. Κατηνιώτης.

[50] Δοκιμές σε χαμηλό ύψος. Χειριστής Κ.Πικρός. Φωτ. Ευάγγελος Μιχαηλίδης.

[51] Ο Β.Κατηνιώτης εκτελεί μια ψηλή πτήση με το «Κικι». Φωτ. Ευάγγελος Μιχαηλίδης.

[52] Υπόθεση για την περίεργη συμπεριφορά κατά την προσγείωση.

[53] Επικαλύπτοντας το Sourissette. Εικονίζονται: Β.Κατηνιώτης, Π.Καλογεράκος, Κ.Πικρός, Ν.Ραβάνης. Φωτ. Β.Κατηνιώτης.

[54] Το Sourissette στον Αυλώνα, κατά την μεταφορά του στον Ορωπό. Φωτ. Κ.Πικρός.

[55] Ο κυρ-Μιχάλης Περσιμιτζάκης πάνω στην «Σουσουράδα». Ο χώρος είναι στα Καμίνια, στα γραφεία της Αερολέσχης Πειραιώς και του ΣΠΑ (Σύλλογος Πειραματικών Αεροκατασκευών) που είχε τότε παραχωρήσει ο Παν.Βαξεβανάκης. Φωτ. άγνωστος.

[56] Ενιαία περιβολή κατά την κατασκευή του Bro. Εικονίζονται: Π.Καλογεράκος, Κ.Πικρός, Κ.Σερπατσένκο, Χ.Μέντας. Φωτ. Χ.Μέντας.

[57] Το ανεμόπτερο Bro στην προσκοπική λέσχη στο Κεφαλάρι. Εικονίζονται: Π.Καλογεράκος, Κ.Πικρός, Αρ.Κοπανάκης. Φωτ. Κ.Πικρός.

[58] Το Bro σε προσκοπική παρέλαση. Φωτ. άγνωστος.

[59] Το ανεμόπτερο Goat στην Κρήτη σαν μηχανοκίνητο. Φωτ. άγνωστος.

[60] Τα πολυεστερικά καλούπια είναι έτοιμα. Φωτ. Λέων Πικρός.

[61] Ο Β.Κατηνιώτης εξετάζει το τμήμα του χείλους προσβολής που μόλις βγήκε από το καλούπι. Φωτ. Κ.Πικρός.

[62] Το ανεμόπτερο συναρμολογημένο για ζυγοστάθμιση. Φωτ. Φ. Πικρός.

[63] Ο Φοίβος Πικρός κατά την ζυγοστάθμιση του ανεμοπτέρου. Φωτ. Κ.Πικρός.

[64] Ακραία εκτόξευση ανεμοπτέρου. Φωτ. από το Ιντερνέτ.

[65] Δοκιμές για πλευρική καλύπτρα είχαν αρχίσει ήδη το 1995.

[66] Δια παν ενδεχόμενον, ας προστατεύουμε τον πισινό μας.

[67] Το διμερές πολυεστερικό καλούπι για το μισό stab. Το ξύλινο μοδέλο βρίσκεται στην μέση.
[68] Κατασκευή του stab. Έχουν ήδη τοποθετηθεί και εμποτισθεί τα εξωτερικά γυαλιά. Έχει ήδη τοποθετηθεί το foam. Τοποθετείται το εσωτερικό λεπτό υαλοϋφασμα. Το foam εδώ και στα ακροπτερύγια είναι απλό Roofmate. Στις πτέρυγες όμως είναι PVC-foam.
[69] Η εξωτερική επιφάνεια του μισού stab βγήκε από το καλούπι. Πάνω στον πάγκο θα ευθυγραμμισθεί και θα ενωθεί με την άλλη μισή.
[70] Τα πέλματα της δοκού (μαύρο pultrusion) έχουν ήδη επικολληθεί στο skin. Ο κορμός της δοκού κολλιέται και συσφίγγεται. Θα ακολουθήσει ένωση των πάντων με υαλοϋφασμα (αφού λυθεί από τον πάγκο και τοποθετηθεί η δοκός οριζόντια).
[71] Ένας εύκολος τρόπος για ερασιτεχνική κατασκευή σωλήνα με ράφι. Σε αυτό προσαρμόζονται τα πλευρίδια του πηδαλίου.
[72] Ευθυγράμμιση πηδαλίου πάνω στον πάγκο και συγκόλληση των πλευριδίων με putty. Κατά το κλείσιμο του σωλήνα σε κάθε θέση πλευριδίου έχει ήδη συγκολληθεί ένας δίσκος από foam, ώστε ο σωλήνας να δρα σαν bamboo. Τα πλευρίδια στην βάση τους δέχονται ένα πρόσθετο λεπτό υαλοϋφασμα.
[73] Τμηματική κατασκευή πτέρυγας σταθερής χορδής.
[74] Το D τις πτέρυγας με λίγα πλευρίδια, ανοικτό στην πίσω πλευρά.
[75] Η πτέρυγα έχει ευθυγραμμισθεί και δέχεται τον κορμό της δοκού που επίσης ευθυγραμμίζεται συμπιεζόμενος.
[76] Η διαδοχική συγκόλληση των πελμάτων της δοκού σε διάφορα μήκη.
[77] Πλευρίδια από PVC foam.
[78] Διαμόρφωση της ρίζας και του drag spar.
[79] Στατική φόρτιση της πτέρυγας.
[80] Το νερό είναι το πιο εύχρηστο φορτίο. Εικονίζεται ο Λέων Πικρός.
[81] Στατική φόρτιση του stab.
[82] Η κατασκευή της ατράκτου απαιτεί περισσότερα χέρια. Εδώ οι "Pikros, Pikros and Pikros" έχουν μόλις τελειώσει το δεξί τμήμα της ατράκτου.
[83] Για την άρση της ατράκτου αρκούν μόνο δύο χέρια. Εικονίζεται ο Λ.Πικρός.
[84] Διαρρύθμιση της καμπίνας.
[85] Διάταξη των χειριστηρίων.
[86] Επεξηγείται στο κείμενο. Φωτ. Β.Κατηνιώτης.
[87] Το σχεδιάκι αυτό δημοσιεύθηκε επανειλημμένως στον «Αεραθλητισμό» σαν γέμισμα, χωρίς κανείς να υποπτευθεί ότι πρόκειται για κάτι υπαρκτό.
[88] Τα πτερύγια του Mosquito.

Front cover. From the book "The Čavka gliders in Greece".
Back cover. From the 1937 Zögling drawing.

ΑΕΡΟΛΕΣΧΗ ΤΗΣ ΕΛΛΑΔΟΣ

Κυρία δοκός 1