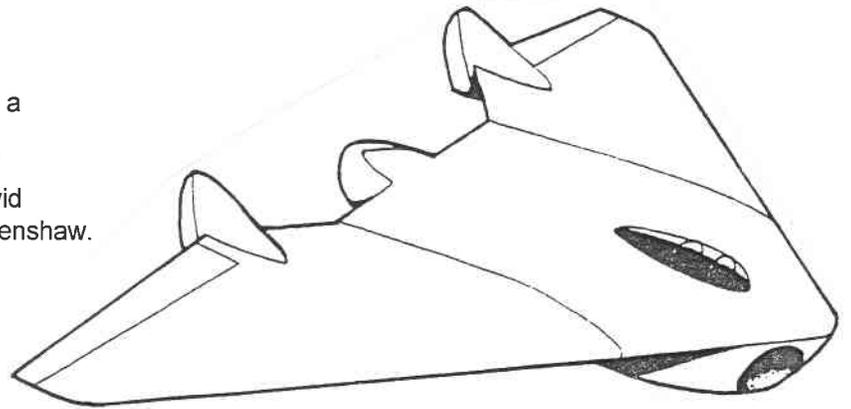


T.W.I.T.T. NEWSLETTER

ARADO E.581-4

An interesting but somewhat clumsy delta-winged concept, the E.581-4 remained in basic sketch design form only. It had a deep boat-like fuselage which housed a single Heinkel HeS 011A turbojet fed by two side-by-side intakes in the extreme nose. Intended as a single seat fighter with tricycle undercarriage, it was to be armed with two 30mm cannon. Wing span was 29' 3 1/2" (8.92m) and length 18' 5" (5.57m). Source: David Master's German Jet Genesis, contributed by Kevin Renshaw.



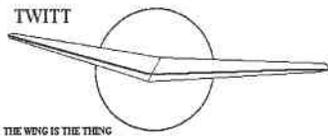
T.W.I.T.T.

The Wing Is The Thing
P.O. Box 20430
El Cajon, CA 92021



The number to the right of your name indicates the last issue of your current subscription, e.g., **9708** means this is your last issue unless renewed.

Next TWITT meeting: Saturday, September 20, 1997, beginning at 1330 hrs at hanger A-4, Gillespie Field, El Cajon, CA (first hanger row on Joe Crosson Drive - East side of Gillespie).



**THE WING IS THE THING
(T.W.I.T.T.)**

T.W.I.T.T. is a non-profit organization whose membership seeks to promote the research and development of flying wings and other tailless aircraft by providing a forum for the exchange of ideas and experiences on an international basis. T.W.I.T.T. is affiliated with The Hunsaker Foundation which is dedicated to furthering education and research in a variety of disciplines.

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Meetings are held on the third Saturday of every other month (beginning with January), at 1:30 PM, at Hanger A-4, Gillespie Field, El Cajon, California (first row of hangers on the south end of Joe Crosson Drive, east side of Gillespie).

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PRESIDENT'S CORNER

This month we are going to break with tradition and present the minutes from the July meeting in two segments. Part I this month will cover Richard Snyder's presentation on his father's ARUP designs from the 1930s. Part II which will be included in the September newsletter is going to cover Marc dePiolenc's presentation on ducted fans for the homebuilder.

I'm doing it this way so that the various pieces of material I have received in the past several weeks on the Flying Wing Symposium at the National Soaring Museum on July 17th can be included. This is somewhat timely stuff and I especially wanted everyone to have a chance to read about the talk by Karl Nickel who had come in from Germany to attend the symposium. It was a last minute surprise that he was able to attend, let alone give a talk on his favorite subject.

One of the symposium speakers, Al Bowers, is also going to be a speaker at the West Coast Sailplane Homebuilders Association meeting at Tehachapi, CA over the Labor Day weekend. If you haven't all ready made plans for that weekend, make sure to come out for either the Saturday or Sunday sessions of informative talks and workshops on sailplane building. Unfortunately, we don't have a complete lineup of the speakers, but past workshops have proven to be worth the trip to the high country for the day or weekend. Don't forget, that's Labor Day weekend at Tehachapi.

In case you didn't notice, this month's newsletter is just a little late. I had a really hard time sitting down at a computer when it was 85-90 degrees in the house even at 9:00 pm in the evening and punch out this wonderful prose. I apologize for the delay.

Hope you're having a good summer of flying,



SEPTEMBER 20, 1997
PROGRAM

The program for September is gradually shaping up. At this time we know **Bruce Carmichael** will give us a first hand report on the Flying Wing Symposium held on July 17th at Harris Hill, NY. This will be more complete than the written version in this month's newsletter, and will give us an opportunity to ask more detailed questions about the participants and some of the side-lights in talking with people like Karl Nickel and Rudy Opitz.

We anticipate **Bob Chase** will be back from vacation in time to assist Bruce in describing the events of the Symposium and tell us about his success in spreading the word about TWITT at the East Coast SHA Workshop that followed.

Keep your eye on this section next month. We hope to have a surprise speaker lined up we know you will all enjoy. **Mark your calendars now for September 20th.**



MINUTES OF THE
JULY 19, 1997
MEETING

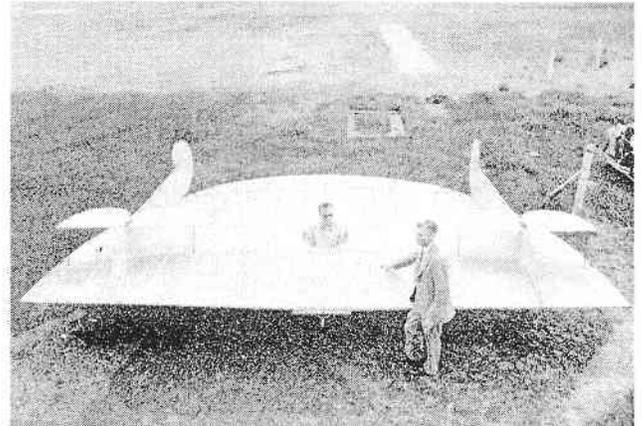
Part I

Andy opened the meeting by thanking everyone for coming out on such a nice day to and joining us for the July TWITT meeting. After the usual housekeeping items he announced that this was also our 11th Anniversary meeting so there would be cake and ice cream at the mid-meeting break.

Andy then introduced our first speaker for the day, **Richard Snyder**, who brought along a very good display of his father's ARUP line of low aspect ratio flying wings. Part of the display had been prepared by Richard's grandson Kajan.

Richard started off his presentation with a short video showing a couple of the models in flight proving that what some government engineers said couldn't fly was in fact circling over their heads. Dr. Cloyd Snyder conceived the idea of ARUP in 1926 and Richard grew up with its development. Dr. Snyder was a foot doctor by profession and had heard stories of airplanes coming apart in the air and he thought that maybe by eliminating the

fuselage it would be one less area for failure to occur.



ABOVE: The ARUP S-1 glider version. Note the vertical surfaces out towards the tips which incorporated the rudder and elevator. Source: Nurflugel web page.

One of the amazing things that Dr. Snyder envisioned in 1931 was a flying wing capable of carrying over 300 people, something that is now done routinely by Boeing 747s and other jumbo jets. His concepts also included many amenities for the passengers like bedrooms for a more pleasant trip. He also had concept drawings of pure transport versions.

The #3 airframe had completed its first test flight and the next day it was found as a burned out hulk. The supposition at the time was that someone perceived its capabilities as a threat to the established scheme of things and destroyed it before it could really prove its worth. The mystery of who burned it was never solved.

The #4 model was the last in the series and had excellent ground handling capabilities. It was powered by 36 hp engine and could achieve 97 mph while landing at 20 mph. The takeoff and landing distances were extremely short, partly due to the very slow approach and landing speed. The aircraft was set up in a controlled pancake descent and just allowed to contact the runway without much, is no, flare being needed.

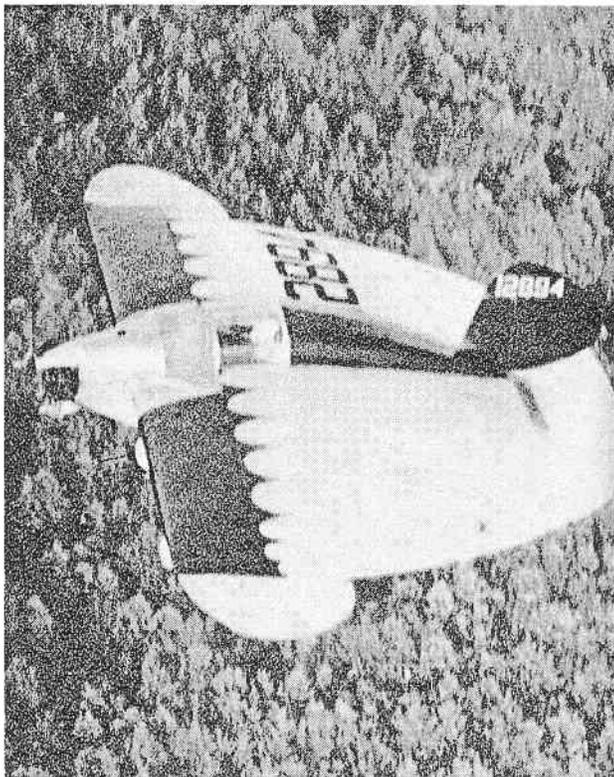
The next part of the video had a number of shots of Milt Hatfield's smaller version of the ARUP called the Little Bird. Hatfield was a test pilot for Dr. Snyder and wanted something that could be built by the average homebuilder. It didn't have quite the performance of the original models, but it was satisfactory of the size and power of the aircraft. Richard wasn't sure of what type of engine Hatfield

was using or what airfoil he had chosen, so couldn't really comment much more on the Little Bird.

Dr. Snyder was not a pilot or an engineer so hired people like Raul Hoffman to do some of the design and engineering work on the first three aircraft. The original idea came from a square section of airfoil he had created out of paper and which flew across the room fairly well. His vision was that people would ride inside the wing which would provide increased safety in the event of an accident.

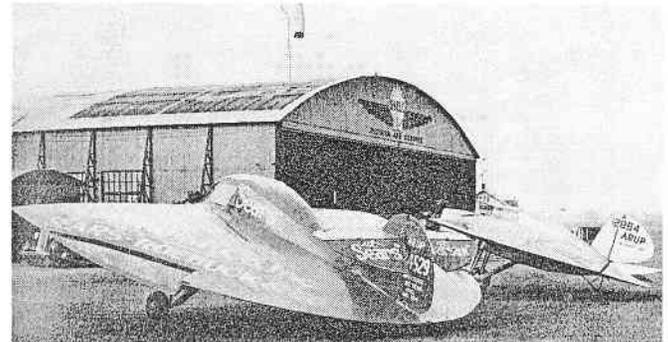
The next evolution was created one day when Dr. Snyder was carving out a felt heel pad for one of his patients. By the time he had scarfed the side and rear edges so the pad would fit down into the shoe, and the straight leading edge to smooth the transition, he found he had produced an airfoil. He gave it a launch and it flew a short distance landing on his desk. If you look at the basic shapes clear up to #4 you can see the influence of this discovery. (Richard commented you can believe this part of the story or not, but that is the way he heard it over the years.)

As the video concluded Richard continued to answer questions from the floor. One question was how had his father been able to finance the construction of these planes. For #4 and man by the name of Stewart who agreed to finance it if he could use it for advertising as a means of getting his money back. This is why you see some pictures of it with Sears logos and name plastered all over the surface.



BOTTOM OF LEFT COLUMN: The ARUP S-2 in flight. Note the addition of wingtip ailerons with a trailing edge elevator and rudder. Source: Nurflugel web site.

Unfortunately, Dr. Snyder couldn't afford to keep the plane and Stewart took it over. He ended up hanging it from the rafters of his garage. When he passed away, his heirs took it down and put it outside where it was eventually stripped and destroyed. Although this was the end of the story as far as Dr. Snyder was concerned, Richard still has an interest in seeing the revival of this unique concept.



ABOVE: The ARUP S-4 (left) and ARUP S-2 (right) sitting on the ramp. Note the inclusion of the ailerons into the wing structure with a more conventional cruxiform rudder and elevator. Source: Nurflugel web site.

Richard explained that #1 was originally a glider and flew successfully without any mishaps. It was eventually fitted with an engine and again performed well. Then #2 was designed as a power plane and was also a great success. Number 3 was a failure in that the engineer insisted on increasing the dihedral, which Dr. Snyder strongly opposed. However, the engineer won the company board's approval and built it with more than the 1% dihedral previously used by Snyder. After the one and only test flight, the test pilot said it wasn't flying right and thought it was because it had too much dihedral. Dr. Snyder made sure that #4 had no dihedral as it was with the previous models.

The question was asked about what airfoils were used. To Richard's knowledge they varied from an M6 to a Clark Y, depending on the tested conducted by the engineers.

When asked about why it hasn't progressed, Richard commented he had asked an engineer at Rohr Aircraft to analyze his father's data. The engineer put the information in his computer and came back with the comment that it was 65 years ahead of its time. This generated a lot of discussion

about the current uses this design could be put too now that it is 60 years later. Some of the ideas were a 4-passenger personal aircraft, short range commercial transport, plush corporate jet, etc., were all discussed to some extent.

With that the group took a break to go back and look at Richard's display material and ask more direct questions based on what they saw. We also started serving the cake and ice cream to help everyone cool down a little bit before continuing with the second half of the program.

(ed. - The second part of the minutes, covering Marc dePolenc's talk on ducted fans, will be presented in the September newsletter in order to make room for the latest information we have received on the Flying Wing Symposium held at the National Soaring Museum on July 17th.)

FLYING WING SYMPOSIUM

By Bruce H. Carmichael
Sailplane Homebuilders Association President

On Thursday, July 17th, a unique program was held at the superb Soaring Museum on Harris Hill, Elmira, New York. This year, the annual Soaring Museum Meeting was to honor three American and two German tailless sailplane designers; Al Backstrom, Jim Marske, Don Mitchell, and Reimar and Walter Horten. A Backstrom Plank, a Marske Monarch, a powered Mitchell U-2, and a Trampeneau high performance foot launched sailplane were on display in the Museum while a Mitchell B-10 and a Marske Pioneer tailless sailplane flew from the hill. Numerous tailless hang gliders could be seen being launched from another position on the ridge.

Paul Schweizer, who had done a herculean task of organizing the Symposium and corresponding with all participants first told how the Symposium came about and introduced Bruce Carmichael as Symposium MC, who in turn introduced the speakers. Jan Scott, indefatigable promoter of the Vintage Sailplane Association and National Soaring Museum gave a wonderful illustrated history of the flying wing designs of the Horten brothers. The many clear slides included some that this enthusiast had not seen before.

Then came Rudolf Opitz, an early Wasserkuppe soaring pilot who became test pilot for Alexander Lippisch on many sailplanes including canard and tailless types and the Me 163 rocket powered interceptor. This modest, superb test pilot told of his adventures as a test pilot and also as a sailplane contest pilot on the Horten IV in the United States. A few of us had met Rudy and his crew chief Willy Elias at soaring meets in the early 50's.

Rudy was followed by Dez George-Falvy who escaped Russian domination following the Hungarian Revolution and became a project engineer with Dr. Gus Raspet at Mississippi State College. He was checked out in the Horten IV by Rudy Opitz and proceeded to do one of the most extensive sailplane flight test programs known to this writer. Dez gave us a detailed account of these tests including an extended recent analysis. His slides were very professional and included beautiful colored flight photos of the Horten IV.

Although most of us are WWII retirees, our next speaker, Albion H. Bowers was a graduate student at NASA Dryden as late as 1982. Fortunately while on Span Loader Aircraft studies in 94-95, this brilliant engineer became interested in flying wings and collected information on Horten, Lippisch and Northrop types on which he gave us a wonderful history and engineering appraisal. This writer immediately pounced on this rare find to speak to us at the West Coast SHA Workshop. I anticipated some wonderful soaring technology contributions from him.

After lunch, Dr. Paul B. MacCready gave a talk on natural and technological flying wings, illustrated with slides and video movies of his artificial Pterosaur and the huge tailless Pathfinder solar powered vehicle which his staff has developed. This remotely controlled craft has just flown to 71,000 feet and larger higher flying versions are in the works. In spite of his many responsibilities, we see Paul drawn back to soaring technology, particularly in the realm of micro lift exploitation and we look forward to MacCready miracles in our beloved realm.

Next came that well known racontraire, Lack Lambie. This sailplane builder, pilot, flight instructor, contest flyer, model builder, aviation writer and sculptor gave a most entertaining talk of his ownership and flying of a Fauvel RV-36. The descriptions of the performance and handling characteristics were followed by a vivid description of it's fondness for ground looping. He told of the

pros and cons of retrieving and transporting a 40 foot span one chunk sailplane.

Al Backstrom who along with the writer, Rudy Opitz and Dez George-Falvy had the good fortune to work with the late Dr. August Raspet in the 1950's, told of his bold development of the EPB-1 Flying Plank sailplanes and the light powered planes. He pointed out the changes in configurations and controls on several models. Planks with tip fins, with center pod fin, and no vertical tail at all were discussed. Al was one of the appreciated members of the FAA prior to retirement and a dear friend of this writer since 1949 when he introduced me to soaring. His talk was illustrated with a series of sharp three view drawings.

Bob Chase, TWITT Vice President, gave a talk on Mitchell tailless aircraft. Bob owns a Mitchell B-10. His talk covered the life and constructions of Don Mitchell from his early days with Hawley Bowlus to more recent times with the Sailplane Homebuilders Association. The photos of Don reminded us of how much we miss this energetic friend. He was an expert in light weight wood construction. His signature was the control flap behind and below the wing trailing edge.

Jim Marske told of the development of his tailless designs starting with a Backstrom inspired Plank. Here he discovered the problem of using the same control surface for pitch and roll. His Pioneer series employed a straight leading edge and swept forward trailing edge together with separate control functions. His Monarch Ultralight sailplane follows the same wing planform and control arrangement with center fin and rudder. His clear three view drawings were a joy. Jim concluded by showing some possible combinations of Pioneer and Monarch configurations for the future.

This unique meeting was enhanced by the attendance of Karl Nickel who came all the way from Germany. This fine mathematician worked with Reimar Horten in Germany in the 40's and in Argentina in the 50's. He told us of his flying experiences in Horten sailplanes. He has written a book, Tailless Aircraft, which is the finest technical writing on the subject. We were all very privileged to hear details of flying wing technology so well explained. His book is available from the AIAA.

Thursday evening the speakers were entertained at the home of Paul and Ginny Schweizer. This unique meeting each year honoring sailplane designers points out the great value of the National Soaring Museum. The East Coast Sailplane

Homebuilders Association Workshop which followed on the next three days illustrated the advantage of combining the two functions. We are already looking forward to next year when Ted Nelson and Harry Pearl are honored for the self launching sailplane, the Nelson Hummingbird, to be followed by an SHA workshop with self launchers as the theme. See you all there.

LETTERS TO THE EDITOR

June 28, 1997

Dear TWITT:

I am sending you the full size plan of a tailless free flight model glider, which I made in 1938. The plan, which I have retraced recently, shows some minor changes if one wants to convert the model to radio guidance. (Personally I prefer the term *radio guidance* instead of *radio control*, since here is no feedback from the controlled item.)

In those days, before WWII, small models like this were used for slope soaring a la free flight style; that is without radio control or automatic magnetic steering, which were not yet available.

After launching the model from the hill top, brave helpers were "unleashed" downhill to rescue the model, a task which could take even a couple of hours if bushes abounded.

Very often, especially for club contests, any site elevated a few meters above ground level was adopted as a "hill."

Once we even tried the bronze statue dedicated to Garibaldi in the city park of my hometown (Abbiategrosso, near Milan). Including the marble base, the head of Garibaldi was about 10 meters above ground level. The most difficult part of the task was to reach the head of Garibaldi without damaging the model.

After we had run a couple of club contests, this practice was halted by the city policeman (alerted by a "spy"), who usually engage in sipping a glass of wine in one of the town taverns.

The model was vaguely based on rumors about what Alexander Lippisch had just done in Germany. Instead of an inverted airfoil at the wing tip, I decided to adopt a large wing twist.

A bunch of "student aviators" obtained one SIDUS from our group and tested it. They reported a glide

ratio of 1:26, which is perhaps too optimistic, although the SIDUS won several "distance contests" always with hand launch.

Myself and my brother built a total of five SIDUS', and about 18 were built by our group. The SIDUS plan is not included in my book, Tailless Tale, because only recently I have found the original sketches in my old family house, upon instigation of Curzio Vivarelli, another Italian TWITT member.

All in all, SIDUS is the model which I remember positively, although I foresee that I won't be able to build a radioguide version of it because of the TMB syndrome (Too Many Birthdays).

Ferdinando Gale'
Via Marconi 10
28042 BAVENO (VB)
ITALY

(ed. - Thanks for the interesting account of how someone can get started in the world of modeling and tailless aircraft.

The plans for SIDUS will be available to anyone who wants them. I am assuming it will cost us about \$4-5 to get it reproduced due to the size, plus postage and handling, but we will give an exact cost if someone decides they would like to try it sight unseen.)

June 21, 1997

Dear TWITT:

Here's our 18 bux. Thanks for the info on the web page. "Project Longshot" is our tailless UAV project; 21' with a 10cc diesel with an autonomous autopilot. Coming along; more later.

Al & Palmer Robinson
3302 Monticello Circle East
Memphis TN 38115
(901) 366-2068
robinson727@worldnet.att.net

(ed. - Welcome to TWITT. Al & Palmer come to us from the Nurflugel mailing list, and were attendees at the recent flying wing symposium in New York. They are consistent contributors of information to the members of the mailing list and we look forward to hearing more about their project as it progresses.)

June 16, 1997

Dear TWITT:

Please find enclosed my VISA card number in order to get a one year renewal for my subscription to TWITT.

If this is a problem, please say.

Hope to give you some news about prototypes from here soon.

Thanks,

Alain MIROUZE

(ed. - I apologize for not getting back to you sooner on this. I thought Bob had included a note in the last newsletter letting you know we don't have the capability to accept credit card payments for membership. Your newsletter will continue awaiting an alternate payment method.

We look forward to seeing more on the prototypes, since the past information you have provided has always been very interesting. The tailless movement still seems to have more momentum in Europe than here in the US, so its good to have members like you who keep us up to date on the latest developments.)

March 8, 1997

Dear TWITT:

Here are my subscription dues, which are late and I apologize.

I actually had decided to quit TWITT, but as long as you membership roster still lists Ed Lockhart, Bruce Carmichael and Ralph Wilcox, I will stick it out some more.

I considered deducting this fee from my tax return under charity, but that does not work anymore. I feel for you all right, but mainly sorry because to me you are a debating club that produces very little.

My suggestion is that you buy an existing design (buy a 80% complete project like a Marske wing) finish it according to the drawings and FLY it - measure what it does and what it needs. You could produce plenty of reports about your findings and develop very useful suggestions to improve it as well as ideas in general about tailless technology (like solutions to control problems).

If you decide on a Mitchell Wing project (B-10 or U-2), I could help you a lot - in spite of my age - but I do not recommend it; the B-10 is flyable; the U-2 is

screwed up to a degree that requires serious modifications before you can chase it down the runway.

Why don't you get busy and DO something?

Faithfully (it requires faith) yours,

Tasso Proppe

(ed. - We are happy that you decided to continue with TWITT for another year. I appreciate your comments on what TWITT is currently "not doing" and I wish there was a way we could "do" more of what you suggest. Our two biggest problems from the very outset 11 years ago was finding enough money to finance such a project, and deciding through a committee effort on the best design for the project. We were never able to overcome either one of them and I don't envision it will happen in the near future without some type of major sponsorship from a private party or corporation. This won't happen until we have someone with the time to put together a campaign to obtain this sponsorship and direct the project from start to finish. And since this is a volunteer organization with many members that have full time jobs and live all over the world, I don't know when that one individual who could pull all this together will appear.

I know all of this is not what you would like to hear, but it is the facts as they stand today. We have had others drop out for the same reasons you are citing, since the originally joined thinking there was going to be some good hands-on building to do and that's what they were interested in almost more than the flying wing concept.

But the organization needs members like you who have a wealth of knowledge and experience with tailless aircraft. Your contributions in helping others solve problems with their own projects is the best thing we can do for everyone right now. If we keep plugging along and keeping the tailless aircraft design alive, the day you are looking for will eventually happen.)

July 23, 1997

Dear TWITT:

Thank you so much for printing the announcement of the Flying Wing Symposium in the June 1997 edition of the TWITT Newsletter. Less than two weeks before this symposium was held on July 17th, I received and read it, and was (fortunately) able to get the tickets in time and fly over the ocean to attend it.

For me it really was worth all the effort since, as you wrote it: "This type of event isn't going to happen again for a number of years". The meeting

was real great, the lectures have been excellent and it has been a real success! The organizers did an excellent job! I assume that in other parts of the TWITT Newsletter you will print more about the different papers delivered there.

I myself have been extremely lucky. Even that it was so short notice the organizers included me into the list of speakers and gave me the opportunity to give a lecture on my favorite theme, namely the role of the location of the center of gravity in designing and flying tailless airplanes.

Attached to this letter is the manuscript of the first part of my paper. If you want to print it in the TWITT Newsletter, please feel free to do so.

In the second part of my lecture, which is not attached, I discussed the circumstances of the death of Robert Kronfeld. He was killed nearly 50 years ago while testing a flying wing. The reason for this accident was most probably a wrong CG location of this tailless glider, the G.A.L./56. This aircraft has been most thoroughly tested by Capt. Eric M. Brown. In his excellent and very readable book Wings of the Weird and Wonderful (1983), Volume 1, he calls it "The worst aircraft I have ever flown". (In case you don't know Robert Kronfeld, he came from Austria and was one of the most successful and famous test pilots in the late 20's and early 30's.)

Thank you again for telling me and the world about that Symposium.

Sincerely yours,

Karl Nickel

(ed. - When I heard that you had attended the Symposium I was absolutely thrilled. I am glad you were able to make it on such short notice and that you were a part of the program. The comments I have seen on the mailing-list about your talk and the exchange of information between you and the other attendees were excellent. Everyone was so excited you were there, since many of them have been talking about a number of things in your book and now have had their questions answered by the author.

I most certainly will publish the first part of your talk in this issue of the newsletter, and I know that the entire Symposium was audio taped by at least one individual who is now a member of TWITT. This will make the rest of your talk available to those who are interested.

Again, thank you for the material. It really made my day when I got it from Bob Saturday as I was trying, in 100 degree heat, to put the newsletter together for this month.)

On the Importance of the Correct C.G. Location on Flying Wings

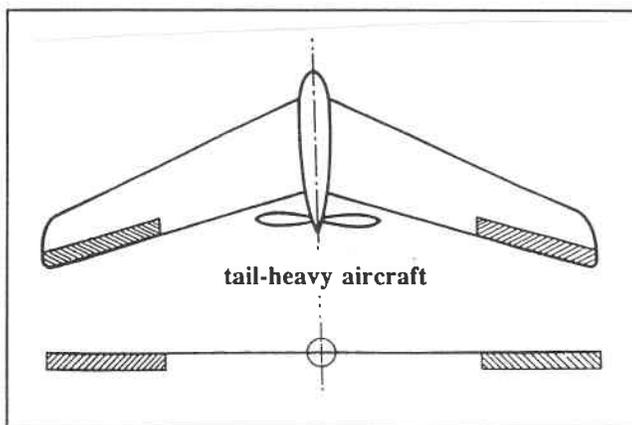
By Karl Nickel, as presented at the Flying Wing Symposium, July 17, 1997, at the National Soaring Museum, Harris Hill, NY.

(ed. - The following was provided to TWITT by Karl Nickel with permission to reproduce it in this newsletter.)

For simplicity, in the following only **sweptback flying wings with elevons at the outer wing parts** are regarded. Hence, e.g. flying planks are **not** considered.

Tail-Heaviness

Let's first assume that our flying wing is **tail-heavy**, i.e. that the cg is too much backwards. Hence, in equilibrium flight we need additional lift at the back for the balance of pitching moments. Due to the backsweep and to the location of the elevons at the tips this lift has to be added at the wingtips, hence, both elevons have to go down there - see the sketch.



Now, this is a very unwelcome situation:

First: This additional lift may lead to **separation** of the flow at the tip and, hence, to **wingtip-stall** with a subsequent **roll-over** which may result in a **spin**.

Second: If this flow separation happens simultaneously at both wingtips, then a "**rear-up stall**" may result, which is especially dangerous near the ground.

Third: Both elevons down means that the wing has **negative twist**. Such wings with negative washout, however, have a tendency for **spiral**

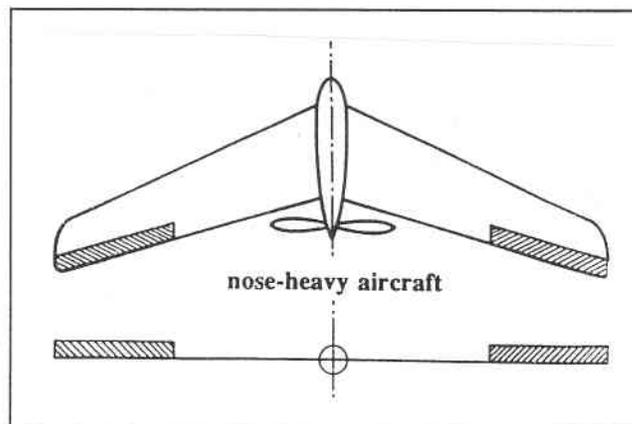
instability. This may not be a dangerous, but it is unpleasant during instrument flight.

Fourth: This negative twist unfortunately amplifies the unfavorable **adverse yaw**, which is a nuisance for any flying wing. Thus control around the vertical axis is weakened.

Fifth: Opposite to popular belief, tail-heaviness gives **no advantage** for the *performances*. If the lift distribution of the wing is chosen optimal for the correct cg position, then tail-heaviness gives more induced drag, i.e. a loss.

Nose-Heaviness

Obviously in this case everything is reversed. Assume, that our flying wing is nose heavy, i.e. the cg is too much in front. Then, in equilibrium flight we need less lift at the back for the balance of pitching moments. Due to the backsweep this negative lift has to be put at the wingtips, hence, both elevons have to go up there - see the sketch.



The conclusion from this is now obvious:

First: This negative lift prevents the **separation** of the flow at the tip and stops, hence, any **wingtip stall**. Therefore, no **roll-over** should be observed and a **spin-proof** aircraft can be expected!

Second: Since no flow separation at the wingtips occurs, also no "**rear-up**" stall should be observed.

Third: Both elevons up means that the wing has **positive twist**. Such wings with positive washout, however, have a tendency for **spiral stability while circling**. This is especially important and pleasant for sailplanes, especially during instrument flight.

Let me tell you, as an example, my own experience while flying the **Horten H III f** (prone

pilot position). In 1944 I entered a cumulus cloud with this ship, even that my turn indicator was not working. At that time I had not - nor have I now - an instrument flight rating. But I had trust in the words of **Heinze Scheidhauer** who had told me: *"In the cloud keep the stick completely back and well centered . . . and wait, until the ground appears again"*. It worked, after a rise of 1000 meters I came out on top of the cloud. The Horten did the constant circling herself, never flying faster than 70 km/h. Completely safe! With which other sailplane of that time would that have been possible? With none!

Fourth: By this positive twist the **adverse yaw** is dampened or even completely annihilated. This strengthens the control around the vertical axis.
Fifth: There is, however, a price to be paid for all these very favorable flight characteristics: If the lift distribution of the wing is chosen optimal for the correct cg position, then nose-heaviness gives more induced drag, i.e. gives a loss. If the nose-heaviness is very large, then this loss may also be very substantial.

An excellent **example** for this are **modern hanggliders**. They have a large positive washout - not as much anymore as the old Rogallos - but it is still a considerable amount. Hence, it is small wonder that they possess excellent flying characteristics, especially at slow speed.

Now you may ask: *"Why would anybody is his right mind move the cg of a flying wing too much backward?"* I have seen this done very often, it happened twice during the last two years with a disastrous result in one case. The "usual" reason for doing so is the observation, that the elevons are in "up" position during "normal" flight. The obvious reaction of the pilots is then: *"Oh, the airplane is nose-heavy, because otherwise the elevons would be in neutral position"*. Then, the cg is moved back, then wingtip stall and/or lateral instability occurs, then the plane goes into a spin or another unpleasant flight situation and very often crashes.

If moving the cg back is wrong, what should then be done in such a case?? Well, the solution should be obvious to any aeronautical engineer:

When the flying wing in normal flight has the elevons up, then the fixed twist of the wing, the built-in wash out, is too small and should be increased!

But, whenever I suggested this remedy in such cases, then invariably came the reply: *"Well, this may be a good solution, but this would deteriorate the performances of the airplane"*. This is true, but:

Flying with the elevons up deteriorates the performances even more!

But, you know, nobody ever did believe me!!! And so, flying wings again and again have been flying with cg aft . . . and have crashed.

If you want to know more about flying wings then read this:

Tailless Aircraft in Theory and Practice
 By Karl Nickel and Michael Wohlfahrt

translated by Capt. Eric Brown RN. ISBN 0 340 61402 1. Edward Arnold, London, Melbourne, Auckland, 1994. Published in the USA by American Institute of Aeronautics and Astronautics, Inc., L'Enfant Promenade, SW, Washington DC 20024-2518.

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