No. 224 FEBRUARY 2005

# T.W.I.T.T. NEWSLETTER

**This is a picture of Dez George-Falvy getting ready for an aero tow at Mississippi State University in the Horten IV that was brought in for flight testing under the guidance of Dr. August Raspet.**

**T.W.I.T.T.**
The Wing Is The Thing
P.O. Box 20430
El Cajon, CA 92021

The number after your name indicates the ending year and month of your current subscription, i.e., **0502** means this is your last issue unless renewed.

**Next TWITT meeting: Saturday, March 19, 2005, beginning at 1:30 pm at hanger A-4, Gillespie Field, El Cajon, CA (first hanger row on Joe Crosson Drive - Southeast side of Gillespie).**

TWITT

THE WING IS THE THING

# 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.

## T.W.I.T.T. Officers:

**President: Andy Kecskes (619) 589-1898**
**Secretary: Phillip Burgers (619) 279-7901**
**Treasurer: Bob Fronius (619) 224-1497**
**Editor: Andy Kecskes**
**Archivist: Gavin Slater**

The **T.W.I.T.T.** office is located at:
Hanger A-4, Gillespie Field, El Cajon, California.
Mailing address: P.O. Box 20430
El Cajon, CA 92021

**(619) 596-2518 (10am-5:30pm, PST)**
**(619) 224-1497 (after 7pm, PST)**
**E-Mail: twitt@pobox.com**
**Internet: http://www.twitt.org**
Members only section: ID – **twittmbr**
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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 (#1720), east side of Gillespie or Skid Row for those flying in).

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## PRESIDENT'S CORNER

I would like to thank Dave Raspet for coming down and giving us an excellent presentation on the life of his father, Dr. August Raspet, and how his work changed many things in the aviation community. I think everyone there really enjoyed the talk as they kept Dave for a while after the program asking more questions. I managed to extract some pictures from the MSU archives available on the Internet so you could see some of the slides Dave included in his presentation.

There was a reference to some Horten IV pictures that were being passed around the group. I have included a couple of these in this issue but will use more of them next month when I have more room to properly display them. They are available on both the Nurflugel and MSU websites, so if you are electronic simply follow the links I have included in the text and take a look at them.

There are no letters this month since the meeting recap took up all the newsletter with the pictures and text. I didn't have very much to include in the letters anyway, so all worked out well.

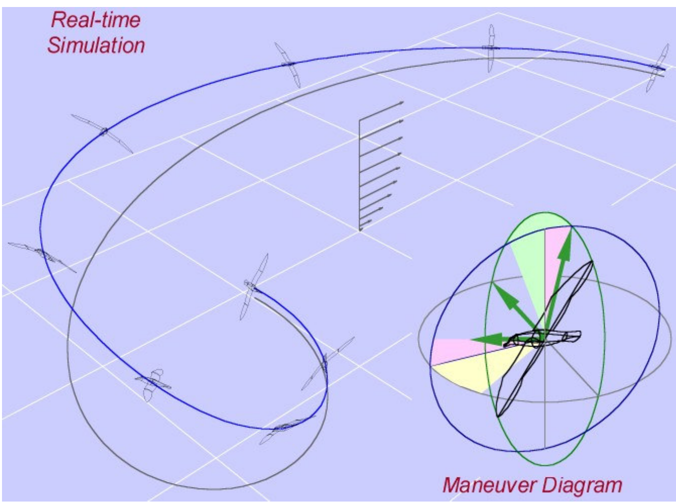
The last two pages of this issue are devoted to the display of a US Postal Service stamp series featuring various cloud formations. I have placed them on the last page so if you like you can cut it out and have the stamps on one side with the description on the other. Or you can go to your local post office and see if they still have any of the stamp sheets available for purchase. As I noted in the section below the stamps, they may be hard to find since only a limited number were originally printed to enhance the value to collectors. This was Bob Fronius' idea since he had received so many positive comments from members about the stamps being used to mail the issues.

I hope that your new year is starting out well and that any projects you are working on have shown progress. Please let us know if you need any advise on particularly sticky problems.

Andy

## MARCH 19, 2005
## PROGRAM

The March program will feature Phil Barnes, a long time TWITT member and past speaker, who will enlighten the group on how the albatross flies over the oceans using dynamic soaring. We have heard a lot about this technique over the years, especially through SHA's Western Workshops, but this will be a more technical overview using all the tools Phil has in his kit bag, featuring photography, paleontology, physics, math, and aerospace engineering, the presentation includes real-time simulations of a wandering albatross executing dynamic soaring maneuvers.




Make sure to mark you calendar right now so you don't miss this program. His presentation will be done with a computer-projected program so the graphics and pictures should be outstanding to view. You won't get the full effect if you wait to see some of them in the newsletter the following month.

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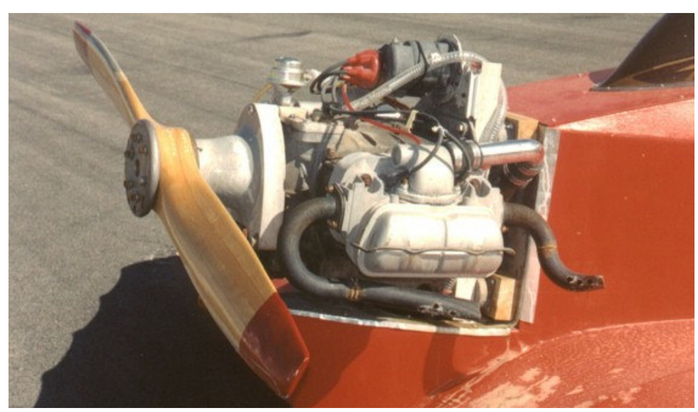
## JANUARY 15, 2005
## MEETING RECAP

Andy opened the meeting by thanking everyone for turning out to the first program of 2005. He announced that we had a program lined up for March, so the year was going to start out very well compared to the past several meetings without speakers.

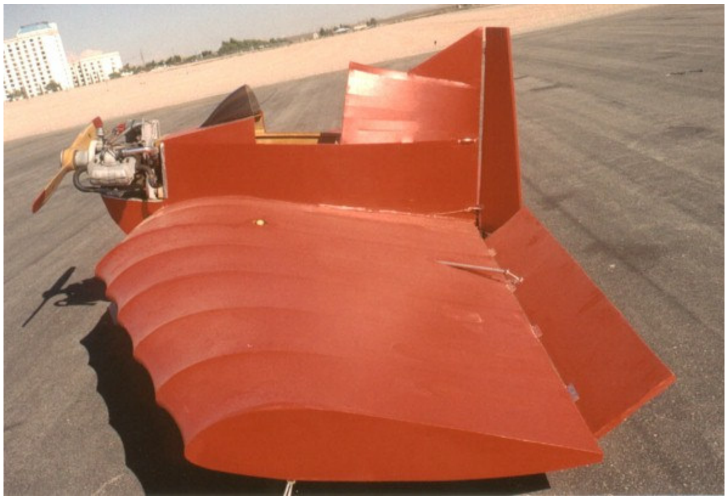
With all that said, he asked if anyone had something to offer the group before getting the program started. Bruce Carmichael briefly commented on the passing of Lyle Maxey who is familiar to most everyone in the aviation community. He was also a frequent visitor to our meetings and made many historical comments on some of the material being presented by our speakers. His niece had come out to California for a memorial service, which was attended by Bruce, Ed LaBahn and Herb DeBreeze. She in turn sent Bruce a thank you note commenting on the support they had given Lyle in the period before he passed away.

Bob Chase showed us some pictures he had taken of an unknown flying wing homebuilt he had spotted at an airport about half way between Stateline and Las Vegas on his way by one day. He inquired as to the owner and whether or not it had flown, but was unable to gather any useful information.

As you can see from the pictures, it sort of looks like someone took the plans from a R/C model kit and blew them up to a man carrying size. The span is about 20' with a 5' chord and thick slightly reflexed airfoil. The control surfaces are simply flat panels hinged very similarly to a model, including no gap covers. The leading edge doesn't include a longitudinal piece to help maintain the contour and there is no D-tube type sheeting as evidenced by the dips between the ribs.



If anyone has information about this aircraft, we would certainly like to hear about it. Or if you happen to have seen a model kit that resembles this flying wing, we would also like to hear about that.



Bob also had some shots of the Boeing X-45A on display at the recent air show. There wasn't a lot of contrast in the photos, but I have included two trying to show the amount of twist in the wing. I hope they come out well enough to see it. You can see more at: http://www.boeing.com/news/releases/2002/q2/nr_020523m.html

Since there were no further offerings, Andy introduced our speaker, Dave Raspet, who would be giving us a look at the life of his father Dr. August Raspet and how it impacted the aviation community over the years. Andy also mentioned he would be passing some Horten H IV photos around that he had extracted from the Nurflugel website. They were taken during some of the flight-testing of the H IV at Mississippi State University under the guidance of Dr. Raspet. *(ed. – Some of them are included later in the newsletter.)*

Dave opened by letting everyone know to ask questions as he moved along through his extensive slide show. He also said he was glad Bruce was present to help him with some of the aerodynamic stuff he might get into during the presentation and, that Bruce was a part of this history he was about to relate. *(ed. – Since Dave showed slides I didn't really have access to very many pictures to scan and include in the newsletter. However, I have searched the Internet and come up with some pictures that are representative of what he showed. One site was: http://www.ae.msstate.edu/rfrl/index.html)*

Dave thought the following were the primary things that defined his father:

- He was a real optimist. To him the half empty/full glass was always almost full.
- He was very enthusiastic. This applied to all aspects of his life, not just aviation.
- He was an extrovert, really enjoying people.

Dave never really appreciated the special character of his father until recently when Alice Johnson, Dick's wife, told his (Dave's) wife that his father's special genius was to encourage others to have faith in their ideas and to go test them. Dr. Raspet's approach was to seek the innovative and untried eagerly, and experiment freely and aggressively.

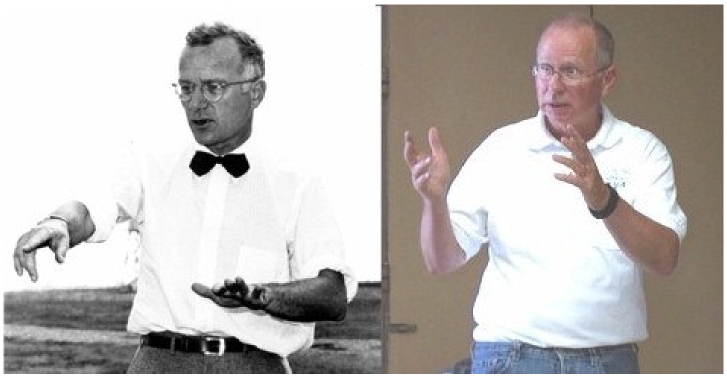
- He was adamant about applying scientific methods in these endeavors.

This was evident in his treatment of people like Paul MacCready who would comment on possibilities and then have Dr. Raspet come back telling him to prove it by showing the data behind the thoughts.

- He was interested in the big leaps in technology breakthroughs. Incrementally approaching a problem may not yield the best results.

When Bruce Carmichael agreed to be on the Soaring Society Scientific Committee that his father chaired, Raspet admonished Bruce to look for broad innovative jumps instead of slow evolutionary developments.

He felt that even in failure there has been an addition to the body of knowledge that would help others in the future to solve the problem or at least see where not to go with an experiment.



**ABOVE:** Father (left) taken from the MSU website and Son as he spoke at the SHA Central Workshop in 2003.

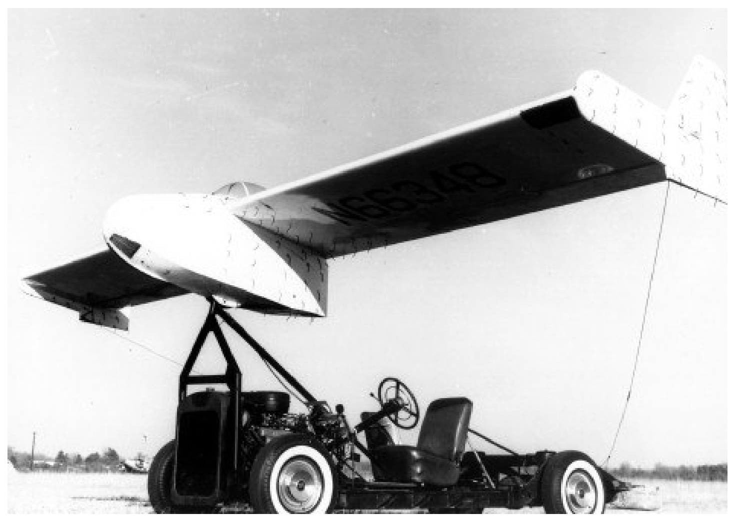
Dr. Raspet's curiosity was insatiable and it drove him into all sorts of diverse activities. His research spanned bird flight, aerodynamics, structural materials, meteorology, and all manner of instrumentation and avionics. Whether he was adapting a new method of solving the Navier-Stokes equations, studying Russian, brewing beer or learning how to propagate violets he brought an infectious appetite to his learning process. We all could not help getting sucked up in his enthusiasm and joining in his fun.

Dr. Raspet was out of the Lindberg era and just fascinated with aviation early on. As a young boy he learned how to build things in his father's machine shop that supported one of the local mines with equipment. Out of the three Raspet children he was the only one that was able to attend college (Carnegie Tech) thanks to his mother's saving enough money from bootlegging.

After college he went off to work for the Geological Survey doing things like measuring the magnetic fields in a particular area. He had to design and build the instruments to perform the work.

Some told Raspet that thermals were columns of hot air rising. So he figured that if he sensed the temperature of the air he could find where the thermals are. He built very sensitive thermocouples that were large due to the amount of wire needed to get the required sensitivity. At the time it seemed like a sensible approach to the problem, but practically it didn't yield any results. An interesting side note, can be found in a 1938-39 issue of Soaring where there is an article written on this subject by Dave's mother. It turned out that the Geological Survey required anything its employees published to be approved by them first. Since Raspet really didn't like authority figures this didn't sit well, so he got around the restriction by having it published under his wife's name.

During WW II he was the technical editor of Soaring magazine and through those years you can see some of his work in the publications. He eventually became chairman of the Technical Committee. He covered subjects like the combined performance of a glider and tow plane, and how much drag reduction could be achieved in a belly-dragger type of sailplane configuration. He was working at the Pratt Read factory and later for a company called Specialties doing work on dive-bombing sites. He also got involved in looking at supersonic flight where he met Parker Leonard and Paul MacCready (prior to his college days).



**ABOVE:** This is an early Backstrom plank on the test rig to determine its handling characteristics. Eventually the tip plates were removed.

Dr. Raspet was fascinated by ridge flow so how do you visualize it. He knew smoke would work but it was hard to move the smoke generators around and take readings. So he decided to use soap bubbles, but since pure soap bubbles don't persist long enough he added glycerin to improve the surface tension. True to his convictions and training, he invented the tool necessary to scientifically analyze the conditions under study.

After the war he became involved in the thunderstorm-measuring project sponsored jointly by the Air Force and Soaring Society. They were flying heavy instrumented Pratt Reads into the storms and filming all of it. Paul Tutland did most of the flying, along with Ray Parker and Wally Wiberg, and there were a great many of tall tales that came out of the whole adventure. The end of the project also seemed to coincide with the Soaring Society's withdrawal from sponsoring such projects without a thorough review by a technical committee.

Dave went through a series of slides from the first nationals contest held at Wichita Falls, Texas, including a couple of shots of the high wing loading Rigid Midget and Scream'n Weiner sailplanes. They did very well against the classic American sailplane of the day and raised the curiosity of Dr. Raspet. He went back home and steamed over what had happened at the contest. Dave wasn't sure if his father provided plans to Farrar or just encourage him to build a high wing loading sailplane, but the Farrar flying wing showed up as a test vehicle. This was a true belly slider with about a 26' wingspan. It was also unusual in that the control sticks were inside the wing roots so the pilot was not only on his belly, but had his arms stuck out into the wings in a spread eagle fashion. To Dave's recollection, the aircraft never flew while under study at Mississippi State, and was according to Bruce's memory the only airplane that Wally Wiberg ever backed out of flying.

**ABOVE:** Dick Johnson's RJ-5 in one of the earlier configurations.

One of the things Dr. Raspet did with many of the sailplanes that came into the MSU research program was to cut the ailerons in half. He found that doing this reduced the adverse yaw without significantly slowing down the roll rate. An example of this can be seen in Jeff Byard's hanger at Tehachapi on the Weihe hanging from the rafters, since it had been through the MSU program.

Dave moved into the sailplane drag reduction work that was done at MSU. He showed a picture of Ray Parker's Tiny Mite where he did the initial modifications from a standard turtle deck to a bubble canopy and, a lot of smoothing on the wings. Further modifications were to remove the wheel and use only the skid. The flat topping increased the span efficiency by removing the mid wing obstruction of the fuselage. All of this work led to it being the first sailplane (perhaps aircraft) with a drag coefficient lower than a turbulent flat plate, indicating a lot of laminar flow.

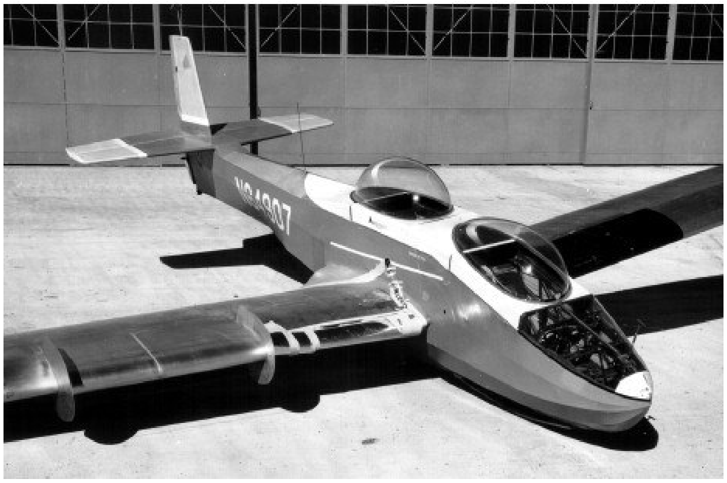
The next step in the evolution was the RJ-5 that Dick Johnson had Harland Ross build for him. Dick Lyons had suggested using a laminar flow airfoil. Ross put in about 2,200 hours fabricating the parts that he shipped to MSU. At that time the wing was moved into a high wing configuration as a result of the Tiny Mite experiments. Dick modified the angle of incidence to gain a little more on the high end knowing he was loosing some low-end capabilities. Over the years it had several different configurations including flaps, spoilerons and, a flattop canopy arrangement. Johnson ended up putting another 2,200 hours into all the modifications. He won the 1950 Nationals with the sailplane. Eventually he managed to improve the performance to 40:1, which was the first time a sailplane had achieved this.

When Johnson first took the RJ-5 out of the trailer in Madrid, Spain at the Internationals, the Germans commented on how ugly it looked. Alexander Lippisch came forward and said it may look bad to the eye but it looks good to the air. Dave commented that not much had changed in that Johnson's current Ventus sailplane looks almost as bad as the RJ-5 did back then.

Over a period of several years there were many changes and a lot of testing done each time a change was made. This was typical of the MSU programs in taking a methodical approach to learning as much as possible to gain in performance.

*(ed. – I missed the fact that the tape had run out so there is a gap in what was talked about here. However, I will give you the best summary I can from memory.)*

One of the slides was the TG-3 boundary layer control ship and there were some of an L-19 and L-21 that also had the wings drilled for these types of experiments. The initiatives for these projects started with Office of Naval Research and then the Army. One of the projects involved smoothing the wings on a Navion, which didn't really improve speed performance but it did enhance the range. This effect was also demonstrated on an L-17 that could go from Mississippi to California in only one fuel stop. Dave commented on just how cold it gets at 14,000' in the back seat with no heat running to save fuel on such long legs.



**ABOVE:** Here is a shot of the boundary layer control TG-3 where you can see the heavily modified right wing and extensive conversion into a flat top configuration.

One of the last projects that his father was involved in was an airship where you could go up on top and actually stand in the boundary layer.


**ABOVE:** A look the modified TG-3 that was used for some of the boundary layer control testing showing the air pump arrangement.

To show the type of passion his father had for learning, Dave related a story about something that started out very simply and turned into a full-blown research analysis. When Dave was about 11 years old he had observed one of his model airplanes appeared to have stalled when it sank in his bath water. He pointed this out to his father, who rather than just dismiss it as true began a technical analysis of what it was doing. He pointed out to Dave that air was a viscous fluid just like water so they should be able to measure the performance of the airplane in the water and determine what it would have done in the air.

So they began making modifications to this little plastic model so that it was properly balanced and would glide in the water. They then started a series of measurement tests with the airplane in different configurations, including without the landing gear and propeller. This testing included using potassium permanganate to create a flow visualization so the vortex performance could be better observed. This all took about an hour and eventually resulted in an article for Scientific American a few years later.

Dr. Raspet and the EAA were a match made in heaven. He would go to the annual gathering and have a great time discussing all sorts of things until the early morning hours. On one such occasion Whitman had brought his Tailwind and they ended up putting some measuring equipment in it and tufting on it to perform some flight tests. The assumption was the boxy nature of the fuselage would have a lot of drag, but to their amazement it actually had very good flow characteristics. *(ed. – My father built a Tailwind many years ago and it performed very well despite its boxy look.)*

**ABOVE:** The Horten IV center section before the wings were attached. Desz Georges-Falvy is at the right.

He talked a little about the work that was done with the Horten IV that Button brought down to MSU. Rudy Optiz did a lot of the flying along with Dez George-Falvy. Some of the pilots who flew it once didn't take another flight because they didn't like flying sideways due to the adverse yaw characteristics. There was some disappointment in the performance since the best they could get was 32:1. For 20 meters that wasn't a bad number, but it was not in same class of some of the newer ships with larger spans like the D-30.

The test report noted that Horten had devoted almost 60% of the span to control surfaces. So any time you were using a control you were really tearing up the airfoil.

**ABOVE:** XV-11A Marvel concept aircraft. Funding appeared to have come from Saudi Arabia since they thought it might be good at landing in the sand.

One of the more revolutionary designs they tested was a test bed using suction boundary layer control and trying to blend high lift and low drag, a difficult combination. The XV-11A Marvel was a ducted fan, fiberglass constructed, turbo-prop aircraft with sponsons so it supposedly could be landed in water or soft ground. It wasn't flown until after Dr. Raspet's death and didn't really achieve the performance levels original anticipated.

The last slide was of the L-21 in which his father was killed. It was an accident looking for place to happen since the boundary layer control pump was engine driven so any loss of power would be a disaster. Dr. Raspet pushed the aircraft to the ragged edge of its limits on many occasions to demonstrate its capabilities, especially in slow flight. He felt it was more impressive to be flying at 30 kts at 100' so you could better visualize how slow the ground was going by.

They don't know exactly what happened, but Dave surmises that either it stalled or there was a failure in a system at low altitude that caused it to crash into the ground with no chance of recovery. Dave made the point that his father took a lot of risks because he was an optimist with a fascination in innovation that produced risky ventures. Dave's experience with the Air Force space program has shown him how risk averse the system has now become, which is a far cry from the time of his fathers adventures and experiments.

**ABOVE:** This was labeled at the L-21B Super Cub variation. It is hard to see, but there is a bump on top of the engine cowling that houses the boundary layer pump that Dave mentioned being engine driven.

With that Dave finished his planned comments. However, the text below represents an overall summary Dave gave during the SHA Central Workshop in 2003 in Moriarity, NM.

**ABOVE:** Since this Bellanca doesn't have a propeller, it looks like one of the aircraft they towed to determine glide performance.

"He loved the unconventional and innovative approach. Advanced airfoils (first, laminar flow airfoils and later the computer-generated airfoils of Eppler), tailless designs, fiberglass for sailplane and aircraft structure, suction boundary layer control for high lift and low drag, man-powered flight, dynamic soaring, solar powered aircraft, thermal detection with very sensitive thermocouples and many more. Not all his efforts proved to be successful, but that didn't deter him. He savored the failures along with the successes because they added to the body of knowledge.

"My father's approach led him to place very high value on flight-testing as the proper environment to understand flight performance. He had little faith in design calculations of flight performance (e.g. best

L/Ds) and not much more confidence in wind tunnels. He led flight test efforts on numerous sailplanes and towed a number of power planes as gliders to get data without the disturbance of the prop wash. He even had them feather both prop's on Bill Lear's Learstar to get data he needed to advise Lear on performance enhancements for Lear's first venture into aircraft modification/production.

**ABOVE:** The top hatch being placed on the Horten IV before a test flight.

"It would be inaccurate to portray my father as a cheerleader for every new idea. To get his support the ideas had to be scientifically sound and the proposed testing comprehensive. Even today as I reread his critiques in Soaring of other's research I cringe at the very blunt nature of his comments. Not personal but very direct. His standard was scientific accuracy and he upheld that standard vehemently.

"What I saw there in Mississippi was an intense "hot house" for new and innovative developments in aviation. Many of them were spectacular. I watched the RJ-5 evolve from a good 30 to 1 sailplane to the world's first 40+ to 1 through careful, comprehensive flight-testing and the meticulous craftsmanship of Dick Johnson. The high-lift, suction boundary layer controlled airplanes seemed to almost hover. Tiny Mite, after careful drag reduction, was the first aircraft with a drag coefficient below a turbulent flat plate. The audio stall warning device let you actually listen to the boundary layer separate as the stall propagated.

"For a long time I regarded these machines as the important product of the flight research efforts in Mississippi. With the perspective of time I now understand that the important product was not the spectacular machines, but the creative people who honed their skills while producing these machines. Dick Johnson and Bruce Carmichael are two of the alumni that have continued with many more significant contributions to soaring and flight research. Another is Dr. George Bennett. George's life was first touched by my father when my father sponsored the local Model Airplane Club. George went on to fly with the Mississippi State Glider Club. As a high school student he and a partner built a Midwest sailplane, he got a PhD in aeronautical engineering and returned to Mississippi State to head the Flight Research Laboratory for 22 years. Many more, such as Dr. Paul MacCready, graciously credit my father with helping to refine their approach to flight research. His influence extends worldwide."

**ABOVE:** Dave answering questions after his talk.

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## AVAILABLE PLANS & REFERENCE MATERIAL

**Coming Soon: <u>Tailless Aircraft Bibliography</u> Edition 1-g**

**Edition** 1-f, which is sold out, contained over 5600 annotated tailless aircraft and related listings: reports, papers, books, articles, patents, etc. of 1867 - present, listed chronologically and supported by introductory material, 3 Appendices, and other helpful information. Historical overview. Information on sources, location and acquisition of material. Alphabetical listing of 370 creators of tailless and related aircraft, including dates and configurations. More. Only a limited number printed. Not cross referenced: 342 pages. It was spiral bound in plain black vinyl. By far the largest ever of its kind - a unique source of hardcore information.

But don't despair, Edition 1-g is in the works and will be bigger and better than ever. It will also include a very extensive listing of the relevant U.S. patents, which may be the most comprehensive one ever put together. A publication date has not been set yet, so check back here once in a while.

Prices: To Be Announced

Serge Krauss, Jr. skrauss@earthlink.net
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**<u>Personal Aircraft Drag Reduction,</u>** by Bruce Carmichael.

**Soft** cover, 81/2 by 11, 220 page, 195 illustrations, 230 references. Laminar flow history, detailed data and, drag minimization methods. Unique data on laminar bodies, wings, tails. Practical problems and solutions and, drag calculations for 100HP 300mph aircraft. 3d printing. $25 post paid.

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34795 Camino Capistrano
Capistrano Beach, CA 92624 (949) 496-5191

## VIDEOS AND AUDIO TAPES

**VHS** tape containing First Flights "Flying Wings," Discovery Channel's The Wing Will Fly, and ME-163, SWIFT flight footage, Paragliding, and other miscellaneous items (approximately 3½+ hours of material).

Cost: $8.00 postage paid
Add: $2.00 for foreign postage

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**VHS** tape of Al Bowers' September 19, 1998 presentation on "The Horten H X Series: Ultra Light Flying Wing Sailplanes." The package includes Al's 20 pages of slides so you won't have to squint at the TV screen trying to read what he is explaining. This was an excellent presentation covering Horten history and an analysis of bell and elliptical lift distributions.

Cost: $10.00 postage paid
Add: $ 2.00 for foreign postage

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**VHS** tape of July 15, 2000 presentation by Stefanie Brochocki on the design history of the BKB-1 (Brochocki,Kasper,Bodek) as related by her father Stefan. The second part of this program was conducted by Henry Jex on the design and flights of the radio controlled Quetzalcoatlus northropi (pterodactyl) used in the Smithsonian IMAX film. This was an Aerovironment project led by Dr. Paul MacCready.

Cost: $8.00 postage paid
Add: $2.00 for foreign postage

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**An** Overview of Composite Design Properties, by Alex Kozloff, as presented at the TWITT Meeting 3/19/94. Includes pamphlet of charts and graphs on composite characteristics, and audio cassette tape of Alex's presentation explaining the material.

Cost: $5.00 postage paid
Add: $1.50 for foreign postage

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**VHS** of Paul MacCready's presentation on March 21,1998, covering his experiences with flying wings and how flying wings occur in nature. Tape includes Aerovironment's "Doing More With Much Less", and the presentations by Rudy Opitz, Dez George-Falvy and Jim Marske at the 1997 Flying Wing Symposiums at Harris Hill, plus some other miscellaneous "stuff".

Cost: $8.00 postage paid in US
Add: $2.00 for foreign postage

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**VHS** of Robert Hoey's presentation on November 20, 1999, covering his group's experimentation with radio controlled bird models being used to explore the control and performance parameters of birds. Tape comes with a complete set of the overhead slides used in the presentation.

Cost : $10.00 postage paid in US
$15.00 foreign orders

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### NURFLUGEL

"Flying Wing"
by Dr. Reimar Horten & Peter Selinger

350 illustrations
German & English text
Limited number of the "flying wing bible" available
Cost: $49.00 plus $4 shipping and handling

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### Tailless Aircraft in Theory and Practice

By Karl Nickel and Michael Wohlfahrt

498 pages, hardback, photos, charts, graphs, illus., references.

Nickel and Wohlfahrt are mathematicians at the University of Freiburg in Germany who have steeped themselves in aerodynamic theory and practice, creating this definitive work explaining the mysteries of tailless aircraft flight. For many years, Nickel was a close associate of the Horten brothers, renowned for their revolutionary tailless designs. The text has been translated from the German Schwanzlose Flugzeuge (1990, Birkhauser Verlag, Basel) by test pilot Captain Eric M. Brown, RN. Alive with enthusiasm and academic precision, this book will appeal to both amateurs and professional aerodynamicists.

Contents: Introduction; Aerodynamic Basic Principles; Stability; Control; Flight Characteristics; Design of Sweptback Flying Wings - Optimization, Fundamentals, and Special Problems; Hanggliders; Flying Models; Fables, Misjudgments and Prejudices, Fairy Tales and Myths, and; Discussion of Representative Tailless Aircraft.

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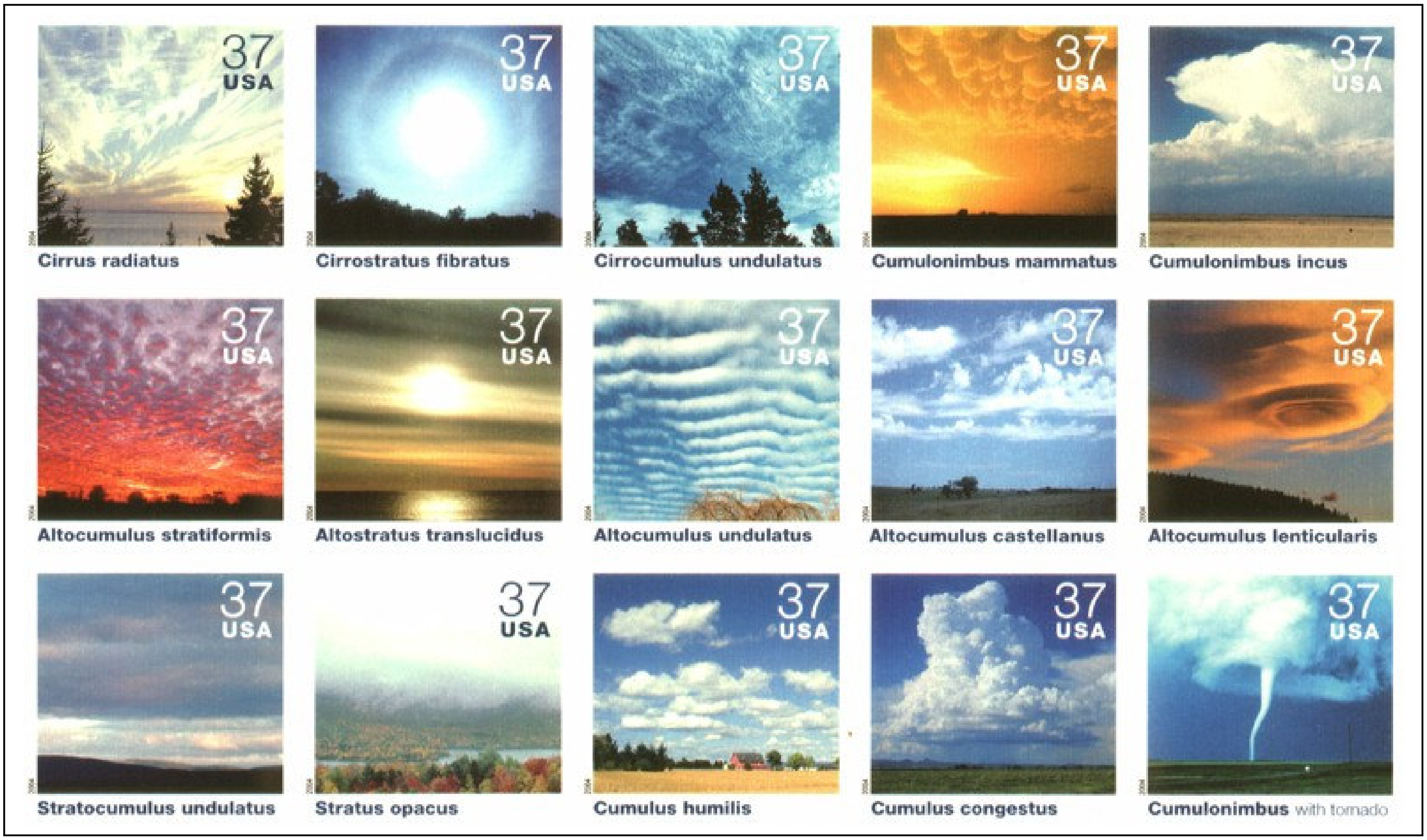


This is a reproduction of the stamp sheet Bob Fronius has been using for some of the past newsletters. We have received several comments on their beauty and how they have enhanced the experience of receiving the newsletter. The next page contains the description for each stamp, and if you cut this page off the back of the newsletter you can flip it back and forth to learn more about these formations. Or you can try and get an original from the US Post Office and see them in living color, but be advised they may be hard to find so you might want to use the phone to call around to nearby post offices and see if they have any in stock. You can to the Postal Store on usps.com and order some or call (800) 782-6724.

From The San Diego Union-Tribune, December 15, 2004, page F3:

“For Jack Borden of Athol, Mass., the stamps represent a mission completed. Sort of.

“Borden, the founder of For Spacious Skies, which promotes awareness and appreciation of the sky and its beauty, began pushing to get clouds on stamps in 1984 as part of his ‘whole propaganda campaign.” He wrote letters to postal officials and politicians, including Massachusetts Sen. Edward Kennedy, suggesting the stamps.

“…Dave Failor, the Postal Service’s executive director for stamp services, said the cloud suggestion was gathering steam. About four years ago, after getting requests for cloud stamps from many sources, the committee asked art designer Howard Paine to come up with a cloud-stamp design. Paine searched photo banks for appropriate stamps. They settled on 15 images.

“The photographs are by a variety of people: meteorologists, storm chasers and average citizens. The descriptions on the back of the stamp sheet were written with the aid of meteorologists.

“The Postal Service’s Failor aid the cloud stamps have been “flying off the shelves.” About 125 million stamps were printed, and roughly 90 percent of them have already been sold. That still leaves around 12.5 million. Once these are gone, that will be it. The Postal Service has an agreement with collectors not to print more in collectible series, so the stamps retain value.”

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|---|---|---|---|---|
| **Cumulonimbus incus**, or thunderstorm clouds, form when rapid updrafts within the cumulus congestus clouds rise into the upper atmosphere and spread out into mushroom-shaped anvils. Thunderstorms always produce lightning, severe storms may produce heavy rain, large hailstones, or tornadoes. | Pouch-like **cumulonimbus mamm atus** develop when pockets of air chilled by evaporating droplets or ice crystals sink into dry surroundings under the anvil. They usually indicate the approach or departure of a potentially severe thunderstorm. | **Cirrocumulus undulates** are patches or layers of small puffy clouds arranged in patterns. They have a rippled appearance due to wind shear and usually cover only a small portion of the sky. | Relatively transparent **cirrostratus fibratus** clouds occur mostly in winter and often produce a halo effect around the sun or moon. Thickening cirrostratus frequently indicate the approach of a frontal system. | Composed of windblown ice crystals, cirrus are librous, often wispy clouds that appear in isolated patches or cover large areas of the sky. **Cirrus radiatus** appear to emerge from the horizon in parallel bands. |
| Smooth, almost motionless **altocumulus lenticularis** clouds resemble lenses and may be iridescent. They often look like UFOs and form in the crests of waves that occur when strong winds cross over a mountain peak or ridge. | Named for the turret-like protuberances in their top portions, **altocumulus castellanus** clouds signify unstable air in the vicinity and often indicate the potential for thunderstorms later in the day. | Resembling ripples on water, **altocumulus undulates** clouds result from wind shear – wind speed or direction that changes sharply with height. They may appear as patches or cover the sky. | **Altostratus translucidus**, cloud streets formed by the rising and cooling of large air masses, often precede advancing storm systems. A 'watery' sun (or moon) may shine dimly through the thinner sections of the cloud street. | Small heaps arranged in layers or sheets, **altocumulus stratiformis** clouds are primarily composed of water droplets and, as depicted here, reflect glorious colors at sunset. If they become thicker during the day, a storm may be approaching. |
| Among nature's most destructive phenomena, **tornadoes** are rapidly spinning columns of rising air extending between the base of a **cumulonimbus** cloud and the ground. In extreme cases, tornado winds may exceed 250 miles an hour. | Strong, buoyant updrafts or warm, moist air in an unstable atmosphere cause cumulus clouds to develop into **cumulus congestus**. These towering clouds can produce moderate rain or snow showers and may grow into cumulonimbus clouds. | **Cumulus humilis** – the smallest of the cumulus clouds – have flat bases and rounded tops. Usually wider than they are tall, these fair-weather clouds very rarely produce precipiation and often evaporate as the sun sets. | Gray, featureless cloud layers that can spread over hundreds of square miles, **stratus opacus**, like stratocumulus, are generally composed of water droplets. Stratus clouds occasionally produce drizzle or light snow. | Stratocumulus undulataus occur when weak updrafts spread horizontally, creating a layer of shallow, puffy clouds that is blown by strong winds into wave-like formations that lie at right angles to the wind, These clouds seldom produce precipitation. |

Clouds develop when moist air cools to its dew point by rising to a higher altitude or by moving over a cooler surface. Water vapor in the air then condenses in liquid or frozen form around minute particles such as pollen or dust. The shapes and altitudes of clouds, as well as the sequences in which they develop, help people forecast the weather.

In the early 19th century, Englishman Luke Howard – chemist by trade and meteorologist by avocation – created a system for classifying clouds using Latin names. He described the three most common shapes as *cirrus* (curl of hair), *stratus* (layer), and *cumulus* (heap); he also defined four compound cloud forms that derive from the three primary shapes, including nimbus (rain). Later scientists added terms such as humilis (small) and incus (anvil) to designate other cloud properties. The International Cloud-Atlas, first published in 1896, is based on this classification system.

Nine of the ten basic cloud genera are pictured on this stamp pane and arranged according to altitude. The prefixes "cirro" and "alto" distinguish high – and middle – altitude clouds, respectively. Nimbostratus, a dark, featureless cloud marked by falling rain or snow, is not shown.