THE TIMES

CAP/EAA BLDG., LEESBURG, MUN. AIRPORT

8507 Airport Boulevard, Leesburg, Florida
MEETS- 9 A.M. EACH 4TH SATURDAY
President/Editor- Bill Schulz, 352.787.9526 schulznotee@yahoo.com
Vice President- Mike Cannon 326.2906
Treasurer- Bill Howard 735.6347
Secretary- John Weber 787.5879
Telephone Chair- Charlie Schnitzlein
Membership Chair- Bill Conderman
Program Chair- Paul Adrien 483.4642
Flight Advisor- Paul Adrien 483.4642
Technical Counselor- Paul Adrien 483.4642

http://groups.yahoo.com/group/EAA534/

JANUARY 2007

DECEMBER

"It was a beautiful warm morning at Bob White's, perfect for inspecting ***Gary Paxton's*** *impressive* ***Velocity*** *project. Gary was a great host, answering the many questions members had about the airplane and he had samples of materials and epoxy types used. A very informative presentation and discussion of fiberglass construction.*

Bill Howard generously provided coffee and goodies and presented plans for our chapter visit to Fantasy of Flight. (The) attendees headed home very satisfied!"

Paul Adrien

DUES DUE- See **Bill Howard** at the next meeting or use the pre-addressed envelope Bill sent you recently.

Host/Builder Garry Paxton *photo: C. Schnitzlein*

"Chemistry 101" *photo: C. Schnitzlein*

"Fly Me to the Moon" *photo: P. Adrien*

"The December meeting at the Bob White air strip went very well.

(EAA Chapter 534) members assembled in Gary Paxton's hanger to view his project. Gary did an excellent job describing the process of constructing his epoxy fiberglass composite aircraft. Gary has done excellent work on his project and is quite articulate in describing the effort he has expended over the last three years.

Gary's Velocity is a four place canard pusher and should be an outstanding aircraft when completed."

Charlie Schnitzlein

"Proud Papa" *photo: P. Adrien*

EDITOR'S NOTE" A special "thank you" to EAA 534 TIMES photo-journalists Paul Adrien and Charlie Schnitzlein

JANUARY - FANTASY OF FLIGHT This will be pre-paid reservations only group. The fee should be about twenty-five dollars. Call Bill Howard at 352.735.6347 **ASAP.**

FEBRUARY- Feb 24: Annual visit to see what's old/new at the **Kimball's** toy shop.

MARCH- Mar 24: Field trip to the new Orlando North Airport, home of **Lou Larsen's "Piet"**

APRIL-April 28: Field trip to see **David Pierce's Cozy**.

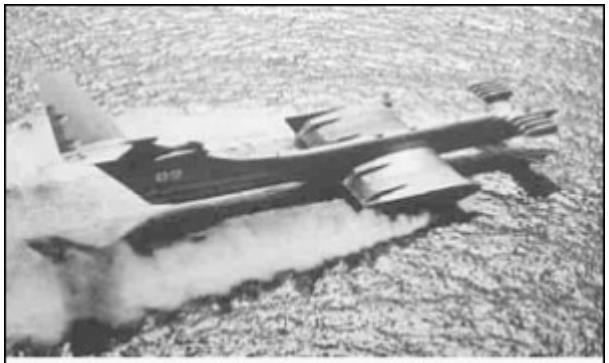
"Mach 1.5" *photo: C. Schnitzlein*

"Critical eyes" *photo: P. Adrien*

Ekranoplan

During the Cold War, ekranoplans (Russian: **экраноплан,** literally "screen plane") were sighted for years on the Caspian Sea as huge, fast-moving objects. The name Caspian Sea Monster was given by U.S. intelligence oper-atives who had discovered the huge vehicle, which looked like an airplane with the outer halves of the wings removed. After the end of the Cold War, the "monster" was revealed to be one of several Russian military designs meant to fly only a few meters above water, saving energy and staying below enemy radar.

The KM, as the Caspian Sea Monster was known in the top secret Soviet military development pro-gram, was over 100 m long (330 ft), weighed 540 tons fully loaded, and could travel over 400 km/h (250 mi/h), mere meters above the surface of the water. Another model was the Lun-class. The ekranoplan has a lifting power of 1,000 tons, among the largest ever achieved.



The "Caspian Sea Monster" model KM ekranoplan

The important design principle is that wing lift is reduced as operating altitude of the ekranoplan is increased (ground effect). Thus it is dynamically stable in the vertical dimension. Once moving at speed, the ekranoplan was no longer in contact with the water, and could move over ice, snow, or level land with equal ease.

These craft were originally developed by the Soviet Union as very high-speed (several hundred km/hour) military transports, and were mostly based on the shores of the Caspian Sea and Black Sea. The largest could transport over **100 tons of cargo**. The development of ekranoplans was supported by Dmitri Ustinov, Minister of Defence of USSR. About 120 ekranoplans (A-90 Orlyonok class) were initially planned to enter military service in the Soviet Navy. The figure was later reduced to fewer than thirty vehicles, planned to be deployed mainly for the Black and the Baltic Soviet navies. Marshal Ustinov died in 1985, and the new Minister of Defence Marshal Sokolov effectively ceased the funding for the program. The only three operational A-90 Orlyonok ekranoplans built (with renewed hull design) and one Lun-class ekranoplan remained at a naval base near Kaspiysk.

"... like this" *photo: C. Schnitzlein*

Boeing has recently taken interest in the WIG phenomenon and proposed a concept for a massive craft to meet a US Army need for a long-range heavy transport. Called the **Pelican**, the 500 ft (153 m) span vehicle would carry up to 2,800,000 lb (1,270,060 kg) of cargo while cruising as low as 20 ft (6 m) over water or up to 20,000 ft (6,100 m) over land. Unlike the Soviet concepts, the Pelican would not operate from water, but from conventional runways using a series of 76 wheels as landing gear.

Ekronoplan with 6 guided missile tubes for "under the radar" hi-speed (250+ kts) attack and escape without detection

The outboard wing

sections, shown tilted downward in the above image to optimize efficiency in ground effect, would be swiveled upward to provide clearance for runway operations. Power for the craft would be supplied by four advanced turboprop engines. The Pelican would also have two cargo decks. The lower deck would be sized for large cargos, including up to 17 main battle tanks, while the upper deck would be used for troops or cargo pallets. With a maximum takeoff weight up to 3,000 tons, the Pelican would have a wing area of more than an acre.


Boeing "Pelican" droop-wing amphib capable of ground-effect or hi-altitude flight... w/ 750 ton payload

The Pelican is a logical extension of Rostislav Alexeiev's work. As big as the KM prototype was, it was simply too small to take full advantage of the benefits of ground effect. Indeed, Alexeiev had proposed much larger versions of the KM and Lun able to carry up to **a thousand armed troops and their ground vehicles**. The principal advantage of a WIG vehicle is the ability to move very heavy loads in a craft with a relatively small wingspan and low aspect ratio wing with great aerodynamic efficiency. Exemplifying this strategy is Boeing's claim that the Pelican is capable of transporting 750 tons over 10,000 nm (18,530 km) when cruising in ground effect, but can carry the same load only 6,500 nm (12,045 km) when out of ground effect.

Flarecraft suffers inefficiency at smaller scale

So the WIG concept is clearly not new, and has been implemented by several manufacturers. However, none has really caught on, and the primary reason is that ground effect craft only become truly practical for very large vehicles, even larger than the massive KM. The reasoning is as follows. As discussed above, the amount of lift a flying vehicle needs to generate is directly related to its weight. The heavier a plane is, the more lift it needs, so the larger its wings must be (for the same cruise speed). This basic relation becomes a problem when we consider very heavy aircraft. As payload weight increases, wing size increases which requires larger and heavier structures that further increase overall weight. As weight increases, additional thrust and fuel is required to push the vehicle at its desired cruise speed over the required range, and the need for larger or additional engines plus greater fuel capacity further increases the overall weight of the vehicle. This trend pushes manufacturers towards increasingly complicated and expensive design solutions that make very large and heavy aircraft unprofitable to build.

However, the beauty of ground effect is that a given amount of wing area produces more lift near the ground than it would at high altitude. Or in other words, the same payload can be transported with a much smaller wing, which translates directly into a smaller, lighter, and more fuel efficient craft. It is therefore not surprising that most advocates of WIG vehicles have focused on very large vehicles, like Boeing's Pelican. This is not to say that vehicles at the other end of the size spectrum have been ignored. Quite the contrary, far more small WIG craft have been built and flown than large craft like the KM. Manufacturers around the world, particularly in Germany, have constructed a variety of small WIG vehicles designed for a handful of passengers. One such example is the L-325, a four-passenger craft built by the **Flarecraft**.

So why haven't these smaller craft become a commercial success? Unfortunately, most of the improvements in efficiency that make a large WIG vehicle attractive do not translate as well across the spectrum to their smaller cousins. The same reductions in induced drag and the ability to lift a given payload with a smaller wing still apply, but the benefits are not as pronounced. While a craft operating close to the ground experiences a reduction in induced drag, other forms of drag are increased. Most importantly, WIG vehicles experience greater skin friction drag simply because the air is denser at sea level than it is at high altitude. A large vehicle can tolerate this increase because the decrease in induced drag is far more significant. But for a small vehicle, the decrease in induced drag and increase in skin friction drag are more equal, so only marginal improvements in overall efficiency are possible.

Furthermore, the increased drag created by denser air at low altitudes limits maximum speed, so a WIG craft will take more time to travel a given distance than a comparable aircraft operating at high altitude. Again, this performance penalty is less significant for a large WIG craft since they would likely be used for transporting large cargos, and speed can be sacrificed for lower cost. Commercial passengers, on the other hand, would be less likely to accept longer travel times than are currently possible with modern airliners.

For these reasons, the future of WIG craft remains uncertain. The potential benefits of ground effect are indeed attractive, but it is unclear whether those benefits are significant enough to warrant construction of large enough vehicles to take full advantage of them. The Pelican is an intriguing concept that could revolutionize the transportation of very heavy payloads, but only time will tell whether or not it is just a pipe dream.