

DIVER



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Flying Subs

Aviators of the Deep





FLYING SUBMARINES TO KILLER WHALES

A BRIEF LOOK AT UNDERWATER FLIGHT, THEN & NOW

Who hasn't stuck their hand out the window of a fast-moving car, angled their flat palm and formed fingers up and down, and marveled at the unexpected force of the air-stream? This simple deflection plane is the basic principle behind the control surfaces or 'airfoils' of conventional aircraft and, with a much different degree of density and viscosity, those of military submarines. Remember, though, that water is some seven hundred times denser than air. Stick your arm and hand out the 'window' of an underwater vehicle moving 50 miles per hour and you may well lose the whole grasping assembly!

The thought of 'flying' underwater, just as an aircraft climbs, banks and dives across the sky, is far from a new idea. In fact, the number of patents granted on submarines with full wings and vertical rudders, in the U.S. alone, is quite amazing. D.V. Reid's 1963 'Flying Submarine' is typical. Thomas Rowe's 'Submarine Hydrofoil' of 1993 claims a submarine vehicle with wings and rudder "either manually or computer controlled by way of hand-held joysticks and foot-rudders". Well, 1993 is relatively recent; how about Joseph Hardo's 'Submarine Flying Boat' of 1922, or Longobardi's 1918 submarine-cum-aircraft described elegantly as a "Combination Vehicle"? There are dozens and dozens of these



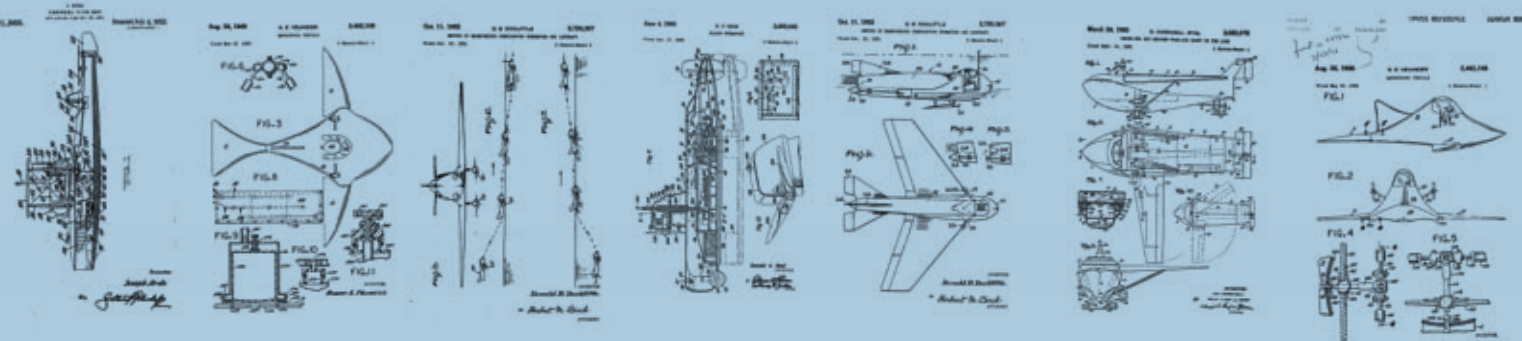
patented designs for 'flying' submersibles – some are quite clever and some are not. Reportedly, a few prototypes were built and flown with varying degrees of success.

The current batch of 'underwater aircraft' has been championed largely by an ex-pat British engineer named Graham Hawkes. He designed several vehicles of this type and has built at least three different prototype versions. The 'Super Aviator' trainer used during the Lake Tahoe diving sessions described in the accompanying articles is one such design.

Hawkes' version of a flying submarine is positively buoyant and relies on a constant amount of down-angle on its control surfaces to stay submerged. If the thrusters stop for any reason, the sub immediately begins to rise to the surface. Conventional submersibles have variable ballast systems and vertical/lateral thrusters that give the pilot the ability to make the sub heavier or lighter in the water – to stop, hover, or sit on the bottom – and to maneuver laterally. The sub then can do a close visual inspection, acquire hi-def video or still images, or operate manipulators to, say, transfer the gold coins from a wrecked Spanish galleon to the subs specimen basket!

The Hawkes subs were built primarily to allow the users to experience the sensation of underwater acrobatics and these subs closely emulate an aircraft in the requirement for continuous forward motion. If an airplane 'stops' in mid-air, it falls quickly to the ground. If a positively buoyant sub stops moving, it 'falls' to the surface – post haste!

The owners of Sub Aviator Systems Inc. used the positively buoyant 'Aviator' and loved the feel of 'flying', although Director John Jo Lewis says, "It's more like a cross between the sensation of riding a high-performance motorcycle and piloting a light



aircraft." But they also wanted to be able to stop and 'smell the roses' (or, perhaps, 'grab the doubloons'!)

Accordingly, 'Aviator' was heavily modified into 'Super Aviator' – a hybrid version that can fly, as it had previously, but now contains the stop and hover capabilities common to virtually all modern submersibles. Other additions included a drop-weight system for emergency ascent, and a full 'self-rescue' system. The modifications worked so well, that it was decided to commission the development of a new model of a multi-purpose flying submarine. The new design was called 'Orcasub' – after the powerful sea-mammals that frequent the coast off the state of Washington where Sub Aviator Systems Inc. is based. Sub Aviator Systems partnered with commercial submersible builders Nuytco Research Ltd., and the final Orcasub design used Nuytco's well-known and Lloyds certified 'Deep Worker' components (pressure hulls, battery pods, etc.) which also serve to increase the depth rating to 2,000 feet (610m) in combination with the wings and rudders of a flying submarine. Super Aviator was retained as an in-house, shallow-water trainer – for demonstrations and for instructing new pilots in the principles of underwater flight.


The original 'Aviator' prototype was not classed by a marine certification agency such as Lloyds Surveyors, American Bureau of Shipping, or Det Norske Veritas. The new Orcasub was specifically

designed to meet all class requirements and to be certified to the same standards as commercially operated submersibles.

As you can see by some of the patent drawings illustrated, flying submarines are not new – but, certainly, Graham Hawkes deserves full credit for re-awakening interest in this type of machine over the past decade, or so. Orcasub may be the most recent of that small crop but, undoubtedly, won't be the last.


So . . . if you have room on your yacht, or have recently inherited a map showing the location of a sunken Spanish galleon, or just want to fly in the 'skies' of the ocean, check out Sub Aviators website at www.SubAviators.com (P.S. Should you be successful with the map and feel like sending me a doubloon, or two, for putting you on to this – it would be an absolutely lovely gesture and most gratefully received!)

Phil Nuytten



ORCASUB

HIGH PERFORMANCE SUBMERSIBLE



SUB AVIATOR SYSTEMS

- Multiple Lift and Tie-down Configurations Enhance Operational Flexibility
- Wings, Batteries and Thrusters may be Jettisoned for Safety
- High Quality Composite Construction
- Vertical Thruster
- Wrap-around Inflatable Emergency Flotation
- Sonar
- Powerful Configurable Lighting
- Bow Thruster

NUYTCO RESEARCH LTD

- HP Breathing Air (BIBS)
- HP Oxygen
- Stern Thruster
- Vertical Thruster
- Responsive, Low-Drag V-Tail
- Spacious Electronics Housings Upgradeable, Expandable
- Surface Rescue System - Pilot Deployable Buoy with 2000' Hi-Strength Line
- Nuytco 'Deepworker' Pressure Hulls Rummy, Ultra Rugged Welded Steel Tested, Certified and Proven in 25 Working Submersibles
- Thrusters - Commercial Off-the-Shelf Economical, Serviceable, Replaceable
- Compact for Stowage and Transport

- A VERSATILE AND INNOVATIVE SUBMERSIBLE FOR RECREATIONAL, COMMERCIAL, SCIENTIFIC AND OTHER USES, INCORPORATING LLOYDS CERTIFIED NUYTCO RESEARCH PRESSURE HULLS AND LIFE SUPPORT SYSTEMS - THE GOLD STANDARD IN THE COMMERCIAL DIVING INDUSTRY
 - INTUITIVE FLY - BY - WIRE JOYSTICK CONTROLS
- 80+ HOURS LIFE SUPPORT
 - QUICK AND MANOEVRABLE IN FLIGHT AND HOVER MODES
 - ADVANCED COMMUNICATIONS, NAVIGATION AND TRACKING
 - POWERFUL, CONFIGURABLE LIGHTING
 - REDUNDANT SAFETY SYSTEMS
 - CUSTOMIZABLE FOR EXPLORATION, FILM AND SCIENCE

Lloyds Certified Depth: 2000' Length: 20' Height: 5' Beam: 14' - 7' Wings Folded



■ Divers attend Super Aviator after one of many test flights in beautiful Lake Tahoe, Nevada. Photo: © Anne Doubilet

FASTER, DEEPER...DRIER!

TEXT BY VICTOR DORFF

Sports that involve putting your life on the line require a little preparation. While you might pick up a tennis racket one day and just start swinging, diving doesn't work that way. That was Lesson One when I was learning how to scuba dive, and now that I was getting ready to "fly underwater," it was clear once again. The submersible I hoped to get a chance to ride, the Super Aviator, was not new to me. Years ago, my wife had been the first female to fly underwater in the winged submersible. Lisa had come home ecstatic about exploring in an underwater craft that used the principles of aerodynamics to slide effortlessly through the water. She spoke of it often since then, even calling it "a great way to go deeper and to stay dry diving without a dry suit." I looked forward to experiencing it myself.

On the banks of Lake Tahoe, I read the flight manual and listened as the professional instructors gave student pilots their preflight briefings. A lot of high-tech improvements had been made to the sub, and there was a lot to remember. Some of the gauges were familiar to me as a diver – O2 readings, depth monitors. In fact, there was a fairly common dive computer affixed to the hull right outside the bubble-dome, in easy sight. Other elements of the training were new concepts, like keeping a slightly negative pressure inside the pod to help maintain a good seal, or using an underwater communication system to stay in constant contact with the mother ship, code-named SubDaddy.

That comm-system had been a little twitchy the day before my flight. The crew had worked on it well into the night, and part of our

mission was ostensibly to test the repairs. In my mind, though, it was going to be all about feeling the ship respond to the controls. In my distant past, I had spent some time in the cockpit of a small plane, and I was looking forward to seeing whether this experience was going to be as much like flying as everyone had been telling me. When it was my turn to shimmy into the tight-fitting seat behind John Jo Lewis, Pilot-in-Command and Managing Director of SubAviator Systems, I couldn't wait to get started.

The Aviator is a high-tech marvel, with a marine foam/resin composite hull wrapped around two independent passenger pods, constructed of sand-cast and machined aluminum and equipped with a life-support system to last 40 hours, if necessary, and the latest in high-tech gear. To make sure it was all running smoothly, we ran through the preflight checklist with Dave Harper, the crew chief, for about a half-hour: Switches on – check. Rudders full-left, full-right, neutral – check...

A five-point harness held me tight to the seat as the acrylic bubble-dome was lowered over my head and sealed. Then, in a moment of incongruity that served as a reminder that we were on a new frontier, the crew used something that looked like a bicycle tire-pump to suck air out of my pod manually, while I called out readings over the radio so they would know when they had created the proper atmospheric pressure.

As the crew rolled the sub backwards, on its boat-trailer, through the parking lot and into the water, a small crowd of onlookers gathered, gawking. The wind had picked up, and the water was a



■ SAS Director John Jo Lewis and Chief Pilot, Fred McLaren, in sub with Explorers Club flag. Photo: © Anne Doubilet



■ Safety divers James Valenzuela and Tim Tarry, behind sub at right, assist in sub recovery operations. Photo: © Anne Doubilet

little rough. Waves licked up over the top of the hull and onto the dome as we began to settle into the lake. I used the multiplex radio to make my first official call to John Jo: "Good news. It doesn't leak." (If he had sounded surprised when he responded, I was going to take that as a bad sign, but his calm voice came back with a reassuring tone.)

A few minutes later, we got the okay for our first dive, and down we went. The murky waters of the lake didn't provide much of a view, but the sensation was fabulous! We were, in fact, sliding through the water, propelled by a quiet electric motor and banking into figure eights at a depth of about 100 feet (31m).

The pods have dual controls, so I could feel the rudder pedals moving under my feet and the joystick rocking left and right as John Jo gently steered the Aviator through its paces. He made it look easy, and I was itching to give it a try.

On the next dive, John Jo aimed us in the direction of open water and said, "Try to maintain this heading and depth." Then came the magic words: "You have the con," he said.

"I have the con," I dutifully replied. Almost instantly, we started to turn... and sink. Clearly, this was not going to be as easy as I had hoped. But John Jo was patient and helpful, verbally guiding me as I slowly regained control. It took a little while, but eventually, I started to get the hang of it. The controls are so delicate that only a light touch is required to keep the wings level.

It seemed like a minute or two later, and it was time to go back in. I had had a chance to fly through some maneuvers, and we had skimmed along the bottom of the lake. In fact, though, it had been just enough of a taste of what is possible to leave me hungry for more.

In many ways, underwater flight is not a substitute for diving. There is a freedom in hanging motionless in a school of fish, or reaching out to touch a wreck. But, there is no reason it has to be either/or. The Super Aviator expands the horizons of someone who loves being under water by providing access to deeper, longer dives without any decompression concerns.

The whole experience was a joy, with only one serious drawback: I'm not sure when or where I'll have the chance to do it again! ❄️



■ From left, Don Walsh, Victor Dorff, Fred McLaren, Boyd Matson and Anne Doubilet. Photo: Courtesy Lisa Sonne



■ Victor Dorff takes a dive. Photo: Courtesy Lisa Sonne

SUPER AVIATOR



■ McLaren, left, on *USS Queenfish*, surfaced in Arctic Ocean polyna, 1970. Photo: Fred McLaren

CAP'N FRED & HIS WONDERFUL ELECTRIC SUBMARINE

AN ASSESSMENT BY A FELLOW PILOT

TEXT BY DON WALSH



■ McLaren with Hawaiian state flag, North Pole, 1970. Photo: Courtesy Fred McLaren

Fred McLaren has an interesting day job as Sub Aviator Systems' (SAS) Chief Pilot for their Super Aviator. A former US Navy nuclear submarine captain, he had some past familiarity with manned submersibles. Nevertheless, flying underwater was certainly different from his experiences during a long naval career.

I was also in submarines during my 24 years in the Navy. In 1959, I became the first commander of the *Bathyscaph Trieste*, and was designated Navy's Deep Submersible Pilot #1. In fact, I believe I may have been the first pilot in the US. In the 1950s there were probably no more than three or four manned submersibles in the world and very few pilots to operate them.

My underwater activities did not end after my three and a half years with *Trieste*. Since that time, nearly a half century ago, I have remained active in all areas of submersible design, construction and operations.



■ SAS Chief Pilot Fred McLaren during pre-flight check. Photo: © Anne Doubilet



■ McLaren on periscope, *USS Queenfish* 1970, Siberian Shelf. Photo: Courtesy Fred McLaren

So, in April 2009, when Fred invited me for a demonstration dive at Lake Tahoe, it was an 'easy sell'. After a microsecond pause I said, "Fred, give me five minutes to get my toothbrush and I'll be there!"

For several years I had been following the Deep Flight submersible series as they evolved through several generations. And I had been invited several times to dive in this new type of manned submersible. However, it always seemed that there were calendar conflicts and I could not go. Now, courtesy of SAS, I would make my first flight in the recently upgraded Super Aviator. Best of all, Cap'n Fred would be my pilot!

Our hour and a half demonstration flight was great, though the water conditions were not great for precise flying. Having made dives in about 40 submersibles, piloting a dozen of them, I was most interested in how this type of vehicle worked. As an airplane pilot (I own a biplane), I was also curious as to how underwater flight would compare to airplane flying.

■ Safety diver watches as Super Aviator dives in the blue of Lake Tahoe. Photo: © Anne Doubilet



I was not disappointed. Super Aviator proved very agile and I got enough 'stick time' to compare it to flying an airplane. I even 'stalled out' once while making a steep turn without enough power. The result was not as abrupt as in an airplane and when we stopped flying we started to sink very slowly. Stop turning, add power and the recovery was very quick. Since Cap'n Fred is also an airplane pilot, the two of us had a good conversation about the relative differences for each mode of transport.

Most importantly, my first flying submersible experience will be a very helpful background as I continue to work with more traditional manned vehicles. I learned a lot and I look forward to the opportunity to do more diving in the latest flying submersibles such as Graham Hawes' new Super Falcon and SAS's new Orca. These 'fast subs' have great promise as a new, efficient means to do work underwater. Thanks to you Cap'n Fred! 🍁



■ Sub pilot Don Walsh with Super Aviator. Photo: © Anne Doubilet
INSET: Aviator Don Walsh in his little red biplane. Photo: Courtesy Don Walsh



SUPER AVIATOR



FLYIN' HIGH AT 87!

OCEAN LEGEND EUGENIE CLARK, A.K.A. 'THE SHARK LADY', CELEBRATED HER 87TH BIRTHDAY IN STYLE, FLYING THE SUPER AVIATOR SUBMARINE! YOU JUST CAN'T KEEP A GOOD WOMAN DOWN...ER, UP.

They say that you can't teach an old dog new tricks – but if the old dog happens to be Genie Clark – a.k.a 'The Shark Lady' – then the saying is utter nonsense! I was privileged to watch Genie learn to operate a deep-diving submersible called 'Super Aviator' and then fly it, deep under the surface of Nevada's Lake Tahoe. She was one of a group of undersea notables who had gathered at Tahoe's Zephyr Cove to test fly an aircraft/submersible hybrid owned by Sub Aviator Systems (SAS) of Bellingham, Washington – but Genie was the only one to take the control of the high tech sub on her 87th birthday!

Ocean VIP's came to participate in the Lake Tahoe event from all parts of North America and abroad. There was Jim Delgado from the Texas Institute of Nautical Archaeology; Bruce Robison and Steve Etchemendy from California's Monterey Bay Research Institute; and France's Paul-Henri Nargeolet, pilot of the deep subs *Cyana* and *Nautilus* and veteran of scores of dives on the sunken ship *Titanic*. Don Walsh, 'the deepest man in the world' co-pilot of the submersible *Trieste* on its world record dive to 35,000 feet (10,700m) – the bottom of the ocean – and DIVER mag board member and columnist, made his way from the coast of Oregon. Bill Anders, a space exploration pioneer and a member of the three-man Apollo 8 crew – the first humans to see the 'dark side' of the moon – flew in from the state of Washington with his son, Alan. Anne Doubilet, New York's award-winning underwater photographer was there, taking lessons from Captain Alfred McLaren, USN (retired), former commander of the nuclear submarine *USS Queenfish*

and currently a director of SAS and one of the Tahoe training instructors. The list goes on and on with notables coming and going during the three week program.

Super Aviator made up to five dives per day – including some interesting dives on the wreck of the *SS Tahoe*. Evenings were given over to watching various submersible videos on the huge flat screen monitor, listening to a ton of great sea stories from the participants and trainees, and, on May 4, an absolutely wonderful birthday party was held for Genie Clark, whose daughter, Aya, son Tak, and youngest son, Nicky, were also on hand to celebrate. Genie has been feted and venerated by almost every international diving group and given virtually every award known to the worldwide underwater fraternity – but it seemed as though this little birthday party was special . . .well, of course it was! How many octogenarians get to continue writing undersea history by diving and operating a new type of submersible? It's pioneers and innovators like Eugenie Clark that the Historical Diving societies of the world were formed to honour.

So, check out Sub Aviator Systems www.subaviators.com and maybe you can hook up on a future training program. If you want to know more about Eugenie Clark – just enter her name into your favorite search-engine, add 'shark' or 'conservation' or just plain ol' 'diving', and stand back. Make sure you have lots of coffee and 'no-doze' tablets handy – you're probably going to be there for a while! 🍁

Phil Nuytten - Photography Courtesy SAS

■ TOP: Genie Clark - aka The Shark Lady - takes Super Aviator for a test spin on the occasion of her 87th birthday! RIGHT: 1. Instruction tent at Tahoe. 2, 3 and 4. Super Aviator is launched. 5. Surface support tender SubDaddy set to go from dockside. 6, 7 and 8. The boat launch is adjacent to Cave Rock. 9. Super Aviator makes one of many dives scheduled over several weeks. 10. A close-up shot of sub controls and instruments. 11. View to bow of sub from aft pilot pod. 12. SubDaddy surface support close by as sub dives in sequence 13, 14 and 15. 16. Back on terra firma. 17. Genie Clark elated after dive. 18. The Sub Aviator base at Lake Tahoe. 19. 'PH' Nargeolet, left, points to massive prop of *Titanic* during one of the evening lectures. 20. Genie with Meghan McDonald.

BOTTOM LEFT: The Sub Aviator test drive team - some of them anyway - including from left, Bill Anders, Dan Basey, Phil Nuytten and Fred McLaren displaying a much handled and travelled Explorers Club flag in front of Genie Clark, James Valenzuela (behind Genie), Meghan McDonald, 'PH' Nargeolet, John Jo Lewis, Dave Harper, Tim Tarry, Tak Konstantinou and John Vance. BOTTOM RIGHT: Genie, front, with her family: daughter Aya and sons Tak, centre, and Nicky.

