WOLFPACK AND SUNDAY COMICS:

The Birth of Anti-Submarine Warfare

A first hand account tells of the early days of helicopter ASW.

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On January 16, 1944, I made the first helicopter flight from a merchant vessel on the high seas in convoy. During subsequent flights we proved that helicopters were practical for anti-submarine warfare (ASW).

The story began during World War II when German submarines, called "wolfpacks," began playing havoc with Allied shipping convoys. While airplanes could attack surfaced submarines, and sonobuoys could track early-model submerged submarines, a new solution was needed when the wolfpacks began operating deeper, quieter, and faster. This called for an underwater echo-ranging device that could operate from aircraft.

At the time, Igor Sikorsky was flight-testing his first helicopter, and in a Feb. 15, 1943 directive, U.S. Navy Admiral E. J. King recognized the helicopter's potential to combat submarines. As commander in chief of the U.S. fleet and chief of naval operations, King ordered the Coast Guard, which is under Navy jurisdiction in times of war, to develop technology to equip helicopters for ASW.

By mid-1942, Sikorsky had built the first YR-4, and Captain Frank A. Erickson and I proved it airworthy in 1943, becoming the Coast Guard's first helicopter pilots.

The Coast Guard's first experience with helicopters was thanks to Britain, which wanted helicopters for ASW and for search and rescue. The Royal Navy acquired two YR-4s and provided these to the Coast Guard, for testing on the merchant vessel Daghestan.

Hell of a start

On January 5, 1944, a convoy was formed in New York's harbor, it consisted of 26 freighters, two British aircraft carriers, three British escort type destroyers, one ocean going tugboat (as our rescue vessel), and the Daghestan with two YR-4s. We were to evaluate the YR4's capability to operate from merchant vessels at sea in convoy, then deliver them to England for SAR use.

British M/V Daghestan with 2 YR-4 Helos embarked on stern, NY Harbor Jan 1944

The project's U.S. helicopter contingent consisted of Lt.Cmdr. James Klopp and Lt.Cmdr. John Miller, both of the U.S. Navy; Giles N. Montgomery from Sikorsky; three Navy photographers; and myself. The UK contingent consisted of Cmdr. Richard Garnett (the mission commander); Lt.Cmdr. E.A.H. Peat; Flight Lt. Jeep Cable; and Lt. Charles Loder.

The Daghestan was one of the smallest and slowest ships in the convoy, top speed nine knots. At 5 a.m. on January 6, the nine knot convoy set out on the North Atlantic route for Liverpool.

The weather was bad from the start, and the convoy soon encountered rough seas, causing the grain-laden Daghestan to roll and yaw excessively. Strong northeast winds and freezing rain, which developed into heavy snow, prevailed during the first three days. On the fourth day out, we were joined by a 13-vessel Canadian convoy that was to accompany us to England. All during the fifth day at sea, the wind and seas built in intensity; at nightfall all vessels were ordered to form a loose formation to avoid colliding. If the weather wasn't bad enough, at 3 a.m. on January 11, the general quarters alarm sounded because submarines were in the area. Donning my life-jacket, I scrambled to my assigned lifeboat with other crew members to be prepared to man the lifeboats.

Within minutes, several explosions were heard. Two vessels directly astern of us were torpedoed, and I could see another in flames on the horizon. Our escorts began employing effective ASW tactics, but three Allied vessels were lost.

After this torpedo attack, the crew of the good ship Daghestan began to appreciate our luck at being aboard a slow and inconspicuous vessel among the convoy's larger ships. German submarine captains probably viewed us as not worth wasting torpedoes on.

Bad weather and a heavily ladened ship means roll and yaw

The rest of that day and the next, the convoy took evasive course changes. No further submarine activity was reported, but we entered another terrific storm just northeast of the Azores. During the storm, some lumber broke loose from on-deck storage. A two by four tore a hole in the aft port fuselage of one YR-4, ricocheted upward to damage the flight actuating control rod in the rotor head, then fell to embed in the port side float, ripping an air compartment. Three men were washed overboard from the rescue tug and lost, and two large crates containing helicopter spares and two liferafts were also washed overboard.

We were taking mountainous seas over the starboard bow, and the wind velocity exceeded 80 knots. With the ship rolling, at times, more than 45 degrees, the Daghestan and its crew took a beating and the convoy steadily broke formation. If this wasn't bad enough, one forward hatch was smashed and sea water entered the cargo area, causing the grain on board to shift and give the Daghestan a permanent list of 5 degrees to port. These conditions amplified the problems of protecting the helicopters from salt spray and seawater that washed over the deck almost continuously during the voyage.

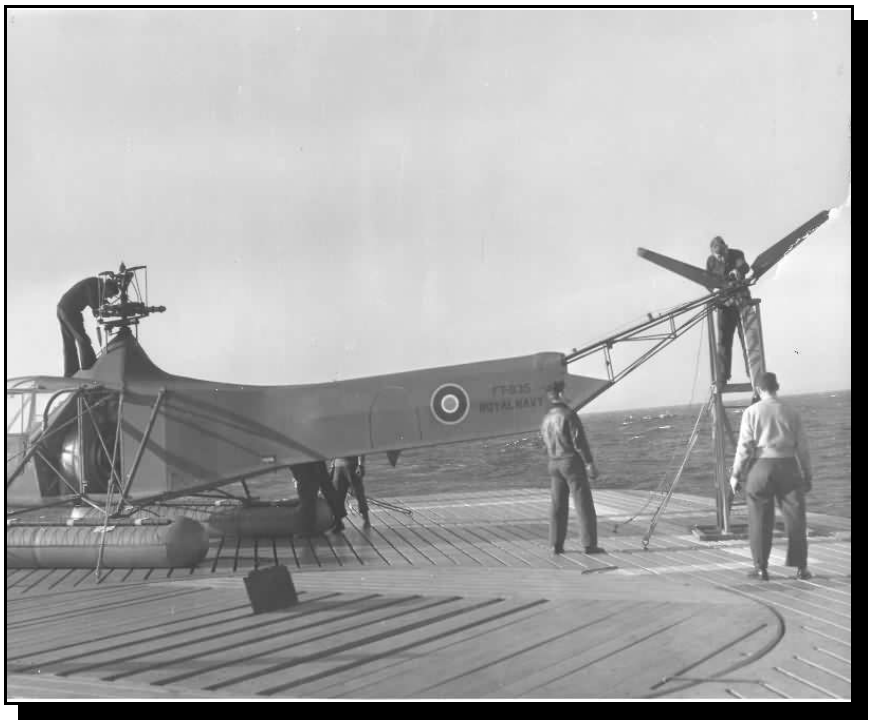
Clear at last

The weather and sea conditions prevented flight operations until the 10th day at sea. The weather had abated somewhat, although conditions were yet harsh.

Before attempting flight, we faced the challenge of installing the main rotor blades. But the ships 15 degrees roll and wet deck made footing treacherous, preventing any wheeling out of the YR-4 on its dolly. It ended up taking 16 men to manhandle the helicopter into position. Then we had to erect a windbreak before installing the blades.

Helo and dolly in stowed position on deck.

Preparing for 1st flight on the high seas from the Daghestan



Mounting the tail rotor on the helo

By the time everything was ready, darkness was approaching. Despite this, I started the YR-4's engine, engaged the rotors, assured the magnetos checked out, then took off. After a quick turn around the convoy, I returned to the Daghestan.

Flights during the following day proved helicopters could be practical for ASW patrol. We finally arrived in Liverpool on January 22, 1944. The YR-4's were flown to a small aerodrome outside Liverpool, and large tents were erected over each YR-4 with armed guards posted for security. These YR-4's became the first operational helicopters in England.

Meanwhile, U.S. efforts to use helicopters became centered at Floyd Bennett Field in Brooklyn, N.Y. Upon returning from the British-American testing, I became the lead pilot instructor at the Coast Guard Helicopter Flight and Engineering School.

I introduced students to shipboard operations by using a custom-designed platform, which simulated a ship at sea. It could be set for a 5 or 10 degree roll within a 10-second period. The unit was christened the USS Mal De Mer.

Another clever innovation was a helicopter flight simulator, built by Atlantic Elevator Co. It was suspended by a system of rails installed in our hangar's ceiling and allowed trainees to feel responses like those of the YR-4. All pilots received their initial indoctrination at this hangar.

By the end of World War II, the Floyd Bennett school was training pilots and mechanics from all over the world. Trainees came from the U.S. military, firms having Navy helicopter contracts, and from Britain, Australia, and New Zealand.

ASW development

While pilots were training at Floyd Bennett, a few scientists at the Naval Research Laboratory in Washington, D. C., were designing an underwater sound recorder to track submerged submarines. The principal developers were Dr. H. C. Hayes and his assistant, project engineer Dr. J. J. Coop.

XHOS Helo with Hayes sonar installed

In early 1945, the Hayes Sound Recording System became available to the Commander of the Anti-Submarine Development Detachment, Atlantic Fleet for testing. The Bureau of Ships and Naval Research Laboratory provided technical assistance, and the helicopter was to haul the Hayes Sound equipment.

In early March 1945, Navy Lt. Roy Rather became the project officer, and Coop reported to Floyd Bennett Field with the prototype sonar. It was first necessary to determine the noise level that the helicopter's main rotor downwash would transmit to the sea, while in a hover.

In the middle of Jamaica Bay, N.Y., the sonar head was lowered beneath the surface from a boat. The Coast Guard helicopter hovered overhead, while underwater noise measurements were taken. The result showed that hovering at an altitude of 20-feet raised the background noise level by about six DBs. This was judged to be low enough not to interfere with the Hayes' sonar capability to decipher submarine noise.

About this time, the Coast Guard had received two Sikorsky XHOS experimental helicopters. The Hayes equipment was installed in one machine, after a lengthy process of modifying its small cabin to accomodate all components.
In early April, Erickson, of the Brooklyn Coast Guard Air Station, suggested that the sonar-equipped XHOS be tested from the Coast Guard Cutter Cobb. Soon the Cobb and the XHOS were dispatched to New London, CT.

XHOS Helo evaluating the Hayes Sonar, Jamaica Bay, Brooklyn, NY
LT S. R. Graham - Pilot & Dr. J. J. Coop - Sonar Operator

Early on April 14, 1945, Erickson, myself, and others boarded the Cobb for a test area off of Block Island. Erickson and I took turns piloting the sonar-equipped XHOS, with Coop and Rather alternating as sonar operators.

To obtain sonar readings on the target submarine, the XHOS had to hover motionless, keeping the suspended sonar cable vertical while dipping the transducer. To do this, the pilot needed a reference on the water to hover over. Float lights and dye markers were tried, but the helicopter's downwash swept both away, making precision hovering impossible.

Finally, it was found that a sheet of the Sunday newspaper comics worked best as a reference. The brightly colored paper soaked up enough water to not blow away, and it could be easily seen at an altitude of 20 to 25 feet.

The testing showed the sonar had sufficient potential to locate and track submarines to warrant development. But while the Sunday comics were OK for tests, an instrument obviously had to be developed to tell the pilot when the cable was vertical.

Coop and his assistant redesigned the sonar's electrical components, and by January 1946, the new dipping sonar (the XCF) was ready. The Coast Guard had a new 450-hp Sikorsky HO2S, and installation of the XCF took about six weeks. Testing again began around Jamaica Bay.

On March 12, 1946, I flew the HO2S to Key West, Florida, with my Coast Guard mechanic, Merwin Westerberg, arriving March 16. We reported to Commander Anti-Submarine Development Detachment (VX-1) for temporary duty.

HO2S-1 with dipping sonar

Cross-country fun

At the time, this helicopter was the largest operational rotorcraft in the United States, and its flight from New York to Key West was the type's first long distance flight. The sight of the HO2S created quite a stir to the population as I flew along the eastern coast, stopping at military and civilian airports en route.

The fun usually began when I requested landing instructions from the tower. The operators would invariably recite routine fixed-wing procedures. By the time I had them convinced that I did not require a runway to land, I was already on the ground in close proximity to the control tower, to their amazement.

During the early stages of the helicopter dipping-sonar program, as with most new ventures out of the ordinary, the people involved were regarded as being out of the ordinary also. Especially the aviator who would dare to fly such a contraption. After flying several hours in these early machines, I would depart the helicopter and walk with a one-per-rev beat for several minutes until I was able to resume control over myself and to unclench my white fists to get the blood circulating once again.

HO2S CGNR 75690 with ASW-XCF dipping sonar

It was up to us, as pioneers, to prove to the military and to civilians, that helicopters were here to stay. Even then, we were laughed at, but look where helicopters are today.

Each morning prior to dawn, my mechanic and I would rendezvous at the seaplane base hangar. We would push open the huge hangar doors and roll out the helicopter to the run-up pad. After a preflight inspection, we would takeoff and fly out over the water. Landing aboard a landing ship tank (LST) became routine, as she proceeded to our operations area.

The HO2S has a tandem-seat cockpit piloted from the rear seat; the sonar operator occupied the front seat. My sonar operator, Coop, was over six feet tall and blocked out much of the pilot's forward visibility.

And the HO2S was inherently unstable and hard to fly because of extreme flight control forces. I alleviated some undesirable features by using a bungee cord, one end secured to the floor board and the other, at the pilot's discretion, to a position on the control stick. It still took sheer strength and determination to maintain a good hovering position with the sonar transducer lowered to a depth of 60 feet.

Full-scale testing

After Coast Guard Ensign William Coffee joined the detachment as a relief pilot and became familiar with the program, full-scale XCF testing began on March 22, 1946. Various water vessels participated: the LST served as the helicopter carrier; a destroyer measured underwater sounds; and several submarines from Key West served as targets.

The program started with a U.S. submarine submerged between Key West and Cuba. It was located by tracking ranges which were considered to be very good. These exercises continued almost daily with Coop and Rather alternating as the sonar operators.

On one occasion, Coop was tracking a submerged submarine, conducting a passive listening test, at a range of 3,600 yards, when he heard Morse-Code signals, which he could not interpret. He continued recording the message until the submarine surfaced.

Believing the operation for the day was over, Coop had the pilot return to the LST. As was the practice at the end of the day, the recordings were played for evaluation among the projects officers. During the Morse-Code section, an officer recognized the message as "submarine has sprung a leak, am surfacing."

Of note, the surface ships assigned to help the submarine in case of an emergency did not hear the urgent underwater message. The event showed the advantage of operating a sonar at the much greater depths used by the helicopter than the shallow depths employed by the surface ships.

Testing continued until May 20, 1946, when the XCF sonar was put through its final evaluation: tracking a captured U-21 German submarine. During the Atlantic crossing, the American crew had learned that the U-21 was faster than American submarines; it could exceed 20 knots while submerged. The U-boat was very streamlined, having no deck structures other than the conning tower.

Tests were conducted to compare the underwater noise level of the U-21 and a U.S. submarine. The subs took stations 1,000 yards apart, and ran parallel to each other at a speed of six knots and a depth of 100 feet,

The sonar-equipped helicopter hovered in the area where the subs dove. Upon dipping the sonar transducer, Coop immediately picked up the high noise level of the U.S. submarine's hull, deck stanchions, chain railings, gun mounts, and antennas. The U-21's noise was detectable, but very quiet by comparison.

Echo-ranging and tracking exercises on the two submarines continued that day, until sufficient data was obtained. When the test results were analyzed, even the most skeptical decision-makers were convinced that helicopter-mounted sonar was the answer for the ASW program.

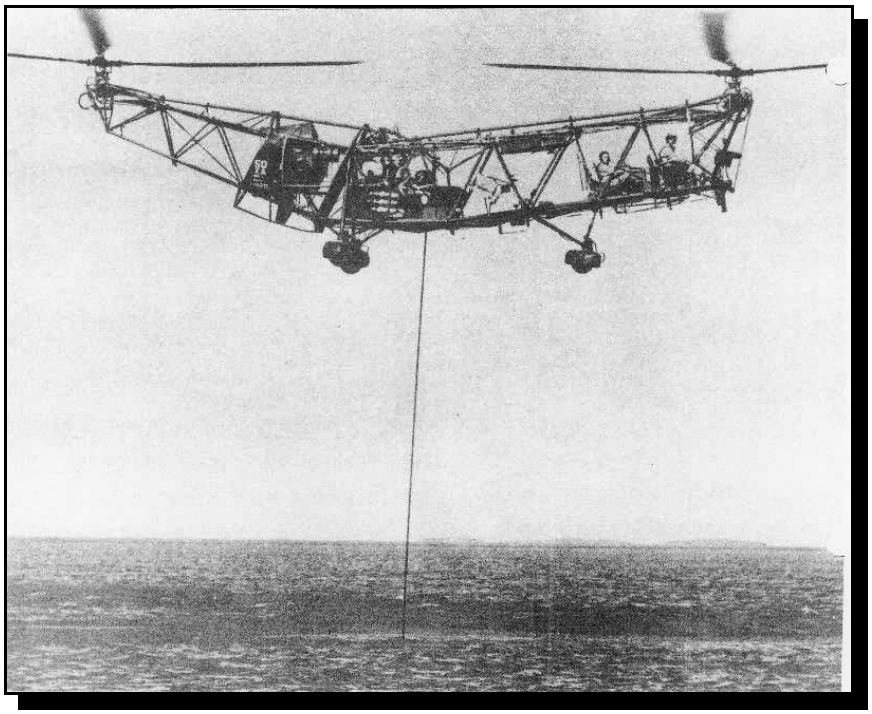
HRPs on patrol

Still, the sonar would have to undergo major modifications for maintainability and supportability if it were to become operational. To make it more compact and functional, the Navy contracted a leading electronics company to manufacture a lightweight "dipping" sonar tailored for helicopters.

The new dipping sonar, AN/AQS-4, was ready for testing in February 1951. An ASW personnel-training program began at the VX-I Detachment in Key West on Feb. 20, 1951. Pilots and crews from the U.S. Navy, Marine Corps, Coast Guard, and Great Britain were present.

I was assigned to the training program. It included evaluating Sikorsky and Piasecki helicopters that could be adapted to carry the AN/AQS-4. It did not take much flight time to discover that the engines overheated during prolonged hovers (up to 15 minutes) in windless, high humidity conditions. But if we removed the fabric from the HRPs fuselage, it was light enough to provide satisfactory performance under the most adverse conditions.

Piasecki HRP



HRP cover off dunking sonar

Eventually, the program used 10 HRPs. The surface vessels consisted of the aircraft carrier Siboney and an LST for helicopters based at sea. Destroyers and submarines were engaged. Each day all mechanical and electronic components used in the dipping-sonar tests of simulated wartime operations were evaluated.

HRP lands on LST

One phase of the program tested a "search and attack" helicopter. It carried the dipping sonar and a torpedo to locate and attack a submerged submarine. The mission was to determine the number of sonar dips needed to detect and then close range on the submarine for a satisfactory torpedo launch.

Flight of 5 HRP's enroute Key West to NAS, Puerta Mariel. Cuba

Another test was to determine the capabilities of a destroyer equipped with an SG-6 radar to control a total underwater screening for submarines by sonar-equipped helicopters. This mission was accomplished by tactically deploying nine sonar-equipped HRPs. The transient geometry of the screens was based on data obtained during previous tests under similiar conditions and was referred to as "probability of detection vs range."

Our heliborne ASW program expanded beyond U.S. waters in 1952, when the Cuban Naval Air Station at Puerta Mariel hosted units of the U.S. Naval Operational Development Force. The force included the submarine USS Amberjack, Escort Patrol Craft 1431, LST 209 and five HRPs.

On Feb. 18, 1952, the Key West Detachment was transferred to Cuba, and ASW exercises were conducted daily. During the testing, large schools of fish would follow the sonar transducer as it was raised, so one crew member packed in fishing gear his next time out and brought back a string of edible fish.

Deep-water echo-ranging continued with much success until mid-March, when a Cuban military uprising forced the detachment to leave Cuba.

Evaluation exercises resumed from Key West, and by the end of August 1952, the Navy accepted the AN/AQS-4 helicopter-sonar package. The pilots and sonar operators had become quite competent, and the Navy recognized them as the fIrst and second Naval Anti-Submarine Squadron: HS-1 and HS-2.

HO4S with Pratt-Whitney 1340 engine and AN/ASQ-4 sonar - 1952

In September 1952, I was transferred to the U. S. Naval Air Test Center in Patuxent River, Maryland, as head of the Rotary Wing section with the Tactical Test Division.

EPILOG

I remember well how the helicopter dipping sonar program was beset by stiff opposition during its early development. However, there has always been a premium and a penalty on pioneering, but both will always be accepted by men of vision.