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President's Message

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As I end my first full year as President of the CLMF I am finding myself reflecting back on a fast paced, exciting experience. In 2018 we completed our first building project and made the move into Ridgecrest. We continued our Lecture Series with topics from Nukes on the Lake (thanks Jack Latimer) to WWII Dirigibles (thanks Brian Siela). We held open houses, receptions, China Lake Tales and Anecdotes, a highly successful Dinner Auction which supports Operations, and put on the 75th NOTS/ 25th CLMF Dinner Gala. Our special thanks go out to VADM Mike Moran, Supervisor Gleason, Mayor Breeden, RADML Dillon, Exec. Director J. Johnson, Pat Farris/ News Review and the Farris Family Singers, Scott O'Neil, Chaplain Crabb, Chief Olson, the Navy Color Guard, Rep. Vince Fong's office, David Livianu and the RC Children's Choir, Ted Lemon, Big Band Express, Carol Porter/ HSUMD and all of the volunteers who made this night so fun. Looking forward to a great 2019!

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Tank Killer—5-Inch High Velocity Aircraft Rocket (HVAR) “Holy Moses”

By Jack Latimer, CLMF Historian

Early Rockets. The German submarine threat was a serious issue in early 1943, as their tactics began to change. They were now surfacing in order to attack allied aircraft because they had greater firepower. Because of this threat the Navy’s aircraft rocket program, under the management of the California Institute of Technology (CalTech) began working on a 3.5-inch forward-firing aircraft rocket (FFAR). It was designed after a British rocket that had proven effective against submarines. The FFAR had a 20-pound solid steel head and a velocity of 1,180 ft./sec plus the velocity of the launching aircraft. The Navy began quantity production after it had proven effective. However, when launched at a submerged submarine the steel warhead had a tendency to break off when entering the water. This problem was overcome after testing different shaped warhead nose configurations at Haiwee Reservoir, and a hemispherical nose was found to enter the water and continue in a straight line.



3.5-inch FFARs being loaded on a TBF Avenger

In an attempt to improve effectiveness the designers fitted the 3.5-inch FFAR with a 5-inch diameter explosive head. While it increased the explosive effectiveness, the increased drag of the larger diameter head slowed the rocket down to only 700 ft./sec. Even so, the Commander of the Pacific requested 100,000 of these rockets per month. The Marine Torpedo bombers found them ineffective against large ships, but still effective for many other targets such as anti-aircraft emplacements. The CalTech team wanted to improve effectiveness against the larger targets, and even before the 3.5-inch FFAR went to the battlefield they started to design a new 5-inch diameter High-Velocity Aircraft Rocket (HVAR).



5-inch FFAR (3.5-inch FFAR with a 5-inch warhead)

The 5-Inch HVAR. The 5-inch motor of the new HVAR would better fit the 5-inch warhead and give it greater velocity. At the first ground test-firing of the new rocket, Conway W. Snyder, impressed with the explosive power was rumored to utter “Holy Moses.” The name stuck and the new rocket became known as Holy Moses. (Snyder, a member of the CalTech team, had also designed the fins for the new rocket.) The first aircraft firing of Holy Moses took place at NOTS on March 30, 1944. By the end of 1944, the Pacific Fleet was beginning to get the new rockets in quantity and to use them with great effectiveness against Japanese transports, anti-aircraft gun emplacements and heavy defense fortifications. The new rocket had a speed of 1,375 ft./sec plus the speed of the firing aircraft.



5-Inch HVAR, Holy Moses

Holy Moses Test Program. The test program for Holy Moses was very successful throughout the development cycle, with the whole development program completed in slightly more than six months. The rocket gave the Navy and Army Air Corps leadership in aviation ordnance that would last for decades. Each rocket had the power of a 5-inch shell. Attack pilots had an effective and reasonably accurate weapon against small targets such as submarines, destroyers, shipping, anti-aircraft positions, ammunition and oil storage dumps, tanks and locomotives. Holy Moses remained in the Fleet for 11 years, until replaced by the more effective 5-inch Zuni Folding Fin Aircraft Rocket.

Taking Holy Moses into Battle. The incredible military success of Holy Moses didn't just happen. It was well planned and executed by the CalTech/Navy team. They didn't just build the rockets and ship them to the armed forces. They sent a team of experienced military officers and scientists to England to oversee the introduction of the rockets into the battlefield. Members of the team included LtCol Harry F. Donicht, head of the Aircraft Section of the Army Air Force (AAF) Command, other military and technical representatives from Wright and Eglin airfields, and Dr. Carl Anderson a leading CalTech scientist. The introduction was closely phased with the rocket production. The AAF and Cal/Tech trained the AAF 513th squadron in how to use the rockets with their P-47 Thunderbolts. And they began by attacking targets in support of the Allied Normandy. The rockets damaged a large number of targets. Pilot debriefings reported 13 tanks destroyed, 2 more probably destroyed, and 10 others hit. One pillbox was hit, 5 trucks and 2 armored cars were destroyed. The squadron lost two aircraft and one pilot in these attacks. The 513th also supported General Patton's tank columns in their breakthrough at Constance in the Brittany Peninsula on July 26th through July 29th 1944. The squadron also played a key role in halting a heavy German counterattack on August 9th.

LtGen Carl Spaatz, Commanding General of the U.S. Strategic Forces in Europe wrote, "The success of the equipment has resulted in a requirement from the Ninth Air Force to equip all P-47 fighter aircraft with rockets. MajorGen E. R. Quesada, Commander of the Ninth Air Force requested thousands of rockets, saying "we want Cal-Tech rockets, not Army Ordnance."

HVAR in the European Theater. Although Holy Moses had been developed for the Navy, it was ironic that the U.S. Army Air Corps was the first user of the new weapon in combat. Immediately following the D-Day invasion in Normandy, France, the Army started requesting 100 complete Holy Moses rockets per day for an indefinite period beginning as soon as possible. The first shipment went out on June 22, 1944 and the last on July 9. Eventually 1,900 rocket motors, 2,000 warheads, 1,700 fuzes, 1496 sets of tail fins, and two boxes of instructions for using the rocket had been received in England.

The original plan was to use Holy Moses to attack German V-2 rocket launcher sites, however by the time the rockets had arrived in England, the Germans had abandoned their fixed launcher sites for mobile ones. It was decided to divert the use of Holy Moses to troop support in the Saint-Lo, France battle area. The P-47 squadrons destroyed so many tanks, armored cars, and pillboxes that an Army general in the Air Tactical Services called Holy Moses "the best antitank weapon of the war."

HVAR in the Pacific Theater. In the Pacific Theater the effect of Holy Moses was very different. By early 1945 all carrier-based and twin-engine land-based combat aircraft were being delivered fully equipped to fire rockets. They proved very effective against point targets—antiaircraft gun positions, ammunition and oil-storage dumps, planes in revetments, and shipping. The rocket made history for NOTS and the nation, and aircraft rockets had become a major weapon of war. The United States had the most effective aircraft rocket, Holy Moses, and was employing it in the largest numbers. Two models of Holy Moses were manufactured: one with a base fuze and a semiarmor piercing head, the other with both base and nose fuzes. Instead of the typical single nozzle motor, Holy Moses had eight peripheral nozzles and one central nozzle.

Dr. W. A. Fowler toured the Pacific Theater combat area in December 1944 and sent many recommendations back to CalTech/NOTS for improvements in the rockets or support equipment. By the end of hostilities the Navy had 1,200 war plants manufacturing rockets with an expenditure of \$100 million per month. Following its fleet introduction in December 1944, Holy Moses served by inflicting death blows to Japanese transports, knocking out antiaircraft gun emplacements, and blasting away heavy defensive fortifications. There were more than 1 million HVARs stockpiled at the close of hostilities. The rockets developed by CalTech/NOTS had become a major new weapon of warfare, and would remain so for decades to follow.

References:

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2. History of the Naval Weapons Center, China Lake, California; Vol. 3. Magnificent Mavericks. By Elisabeth Babcock.

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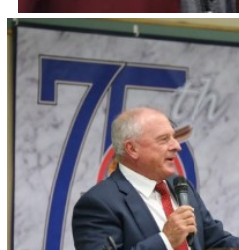
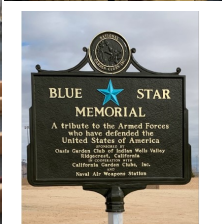
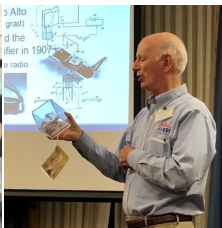
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