THE CHINA LAKER

Vol. 16, No. 1 | Newsletter of the China Lake Museum Foundation | Winter 2010

PRE-NOTS CALTECH ROCKET PROGRAMS AND THE FIRST EFFECTIVE COMBAT SYSTEM – THE BARRAGE ROCKET

Editor's note: Dr. Charles C. Lauritsen, a key leader in the founding of the Naval Ordnance Test Station (NOTS) at China Lake, led CalTech in research in the early rocket projects some three years before the establishment of NOTS. The Lauritsen Laboratory at China Lake is named after Dr. Lauritsen, as is the Lauritsen Crater on the moon. The early work leading to the barrage rocket provided a template for many future programs at China Lake: Develop highly effective weapons in a short time that are easily produced and at low cost. Most of this material is taken from Vol. 1 of the China Lake history, Albert B. Christman, Sailors, Scientists, and Rockets. History of the Naval Weapons Center, China Lake, California, Volume 1. United States Government Printing Office. 1971.

Until World War II, the U.S. Navy had shown but sporadic interest in rockets as weapons. The tide turned with the establishment of the rocket program at Caltech. Less by design than happenstance and mutual bias for solid propellants, the CalTech program became one sponsored almost entirely by the Navy. So close did this tie become that the true point of beginning for continuous Navy involvement in rocketry can be defined as the CalTech rocket program.

The first CalTech rocket product was a target rocket, a rocket neither designed for nor used for combat. But it served two useful military purposes. First, over 21,000 military personnel sharpened their gunnery firing at these speedy, erratic targets. More important, it provides an uncomplicated vehicle for CalTech's early experimental work with propellants. The dry extrusion process pioneered by CalTech led to the widely used double-base propellant formulations.

The CalTech weapon to follow the target rocket was a 7.2-inch-diameter antisubmarine rocket (ASR) whose launchers became popularly known as the Mousetrap. By late 1942 the system was being extensively used along the Atlantic coast and in the Caribbean, and by early 1943 saw extended use in the Pacific theater. It goes down in history as the first CalTech rocket to be fired against the enemy. And since the CalTech program became the beginning of the Navy's modern rocket program, the antisubmarine rockets launched from Mousetrap launchers were the first Navy rockets of the era to see tactical use.

The next CalTech rocket was the retrorocket developed as the weapon partner to the submarine detection system known as MAD. It was the magnetic anomaly detector, later called the magnetic airborne detector, which gave a signal when flown over a mass of metal such as a submarine. The problem was that when the MAD gear told the pilot there was a submarine directly beneath him, it was too late to drop a bomb or depth charge. From the CalTech group came the idea in February 1942 of launching the ASR rocket rearward from the airplane at a velocity equal to the aircraft's forward speed. According to theory, the projectile then should fall straight down. The retrorocket ASR was deployed by the spring of 1943, and by the end of the war, CalTech had produced 50,000 rounds, a large number for early in the war, but small compared to the total number of rockets produced.

The Barrage Rocket

The next rocket program to be started at CalTech grew out of a conversation on June 16, 1942, between Lauritsen and Vice Admiral Wilson Brown, newly appointed Commander of the Amphibious Forces of the Pacific. Brown was attending a demonstration at Goldstone (a present day NASA tracking station on U.S. Army Ft. Irwin grounds, very near the east boundary of Echo Range) of the Mousetrap-launched ASR and other rockets.

Lauritsen asked Brown if he thought the rockets would be useful in the Pacific for defending troop positions. Brown replied, "Hell no, we aren't going to defend anything; we're attacking from now on!" (Note: This pronouncement that the United States was shifting from a defense to offense came a few days before the full retreat of Admiral Isoroku Yamamoto's forces at the Battle of Midway, which was a turning point of the war in the Pacific.) That sounded good to Lauritsen, who responded, "What can we do to help?" Brown pointed out that there was a great need for a weapon with a range of 1,000 to 1,200 yards that could be fired from landing craft as they approached shore, at which time it became necessary for the Fleet to lift its barrage.

A rush program for barrage rockets followed. It represented one of the fastest responses in history of a technical program to new battle requirements. Twelve days after the conversation with Vice Admiral Brown, test models of the 4.5-inch barrage rocket combining the elements of the antisubmarine and other rockets were being successfully tested. The fuzing was a more involved development, but a workable system was available by August and on August 25, 1942, a demonstration was staged at Solomons, Maryland. Following the pattern of other successful rocket demonstration during the war, there was immediately forthcoming, this time in four days, a Bureau of Ordnance request for immediate delivery of operational weapons. In this case the request was for 50 launchers, 3,000 rounds, and 3,000 fuzes to be delivered to the Amphibious Force of the Atlantic Fleet within 30 days. The deadline for delivery was the clue to an urgent operational need.

In order to have the rockets when needed, CalTech not only did the development work but also managed the production. The CalTech personnel were spurred on by the implication that the barrage rocket would provide a way of carrying out an important military operation with a smaller loss of American lives. There was only way to do the job, and that was for everyone, no matter what his professional background, to "turn to" wherever he was most needed. The Navy handled priority problems. The Institute procured and delivered materials to subcontractors. Scientists and engineers became expediters and inspectors. Office workers doubled at assembly lines after regular hours. Rocket components overflowed the physical capacity of CalTech's Kellogg Laboratory and filled other campus buildings and outdoor areas. It was a hectic time; but on October 10 the last of the rockets were delivered and flown East to meet the deadline.

The barrage rocket was used on November 8, 1942, (Note: A full year before the establishment of NOTS) at Casablanca and contributed to the success of the assault. This was only 70 days from the time the Bureau requested the weapon. It was a dramatic demonstration of what a closely knit technical group could do when the need was clear and administrative barriers were removed.

The crisis of the barrage rocket production added to the growing realization of the CalTech group that the normal procedures of completely separating production from development would not work in wartime without great loss in time and, consequently, lives. The scientists reasoned that if interim production was going to be a repeated fact of life, they should prepare for it. A special section for production was set up at the Institute under Trevor Gardner in November 1942. This was the beginning of the extensive network in Southern California plants set up by Gardner for making the various metal parts for rockets. There was a great need for this organization in the months ahead. Bureau production of the barrage rocket was to start by the late spring of 1943, but it was not until much later that the necessary volume was reached. The demands were running at about 20,000 rounds per month. In view of this urgent need, CalTech continued with the production into 1944. It produced only part of the total of 1,600,000 barrage rockets made during the war, but it filled the gap during the critical first stage when it was the only source for this effective weapon appropriately nicknamed "Old Faithful."

This rocket was used in every major landing in the European Theater. At Salerno Old Faithful silenced gunfire from the beach as waves of landing troops moved in. In the invasion of southern France the launchers of the landing craft were loaded with explosive heads, and the reloads were smoke rockets.

The barrage rockets became standard ordnance for landing craft and patrol boats. The first extensive use of a rocket barrage in the Pacific Theater was at Arawe in December 1943. From then on, rockets were major weapons in the war in the Pacific. By the end of the war each Marine division had a rocket detachment. Typical equipment included 12 one-ton trucks, each with three 12-round launchers. At such battle sites as Saipan, Tinian, Iwo Jima, and Okinawa these were used to give concentration fire for special needs.

As interesting as the special uses were, the main application of the barrage rocket was in laying down massive barrages for amphibious assaults. The first craft to be equipped was a small patrol boat, but the later trend was to use the rockets on larger landing craft that could handle more launchers and more rounds to produce the heavy saturation desired.

Summary

To summarize CalTech's pre-NOTS rocket programs: The target rocket proved that rockets could be useful even if not only for limited training needs and focused the experimental work on the critical propellant problem; the ASR with the Mousetrap met a limited tactical requirement and proved that rockets could be militarily practical as shipboard weapons; the retrorocket despite limited use, dramatized a unique scientific approach to the submarine problem; and the 4.5-inch barrage rocket became the first military rocket to be used effectively by this nation in large quantities and had significant impact on the war. On the basis of these programs, there was recognition in the Navy and the Office of Scientific Research and Development that CalTech was a "can do" organization in rocketry. There is no longer any doubt that rockets were effective weapons of war. Henceforth the Navy was committed to the development of rockets as standard ordnance for the fleet.

The Museum - CalTech to NOTS

The Museum has a display we call the "Rocket Wall", which has models of several of the CalTech/NOTS programs of World War II, leading up to the most modern unguided rockets being used today in the form of the 2.75-inch rocket and the 5-inch Zuni. China Lake, among many other things, is known for designing weapons that are accurate, have simplicity in design, meet a Naval requirement and are improvable to meet a changing threat without requiring the cost and delay of developing an entirely new system.

An example of improvability is shown on the rocket wall. In the early 1940's Cal Tech had designed a 3.5-inch anti-ship fixed-fin rocket. It was soon found the small 3.5-inch warhead was insufficient for modern day ships. So the first improvement was to replace the small warhead with a 5-inch gun projectile warhead. The result was a very effective warhead but the additional weight slowed the missile's speed by about half. China Lake then developed a 5-inch rocket motor and attached the 5-inch warhead ... producing what became known as the 'Holy Moses' ... a name that was inspired when a young Naval officer upon hearing the rocket motor and the destructive power of the weapon exclaimed, "Holy Moses!"--- makes you wonder what it might have been called if it was invented today. Holy Moses, more properly designated as the High Velocity Aircraft Rocket (HVAR), became one of the most effective rockets of WWII ... used against ships, pillboxes and other hard targets.

In June 1950, NOTS was visited by Navy operators then fighting in Korea. They expressed deep concern over the fact that Russian tanks had been introduced into the theater and that our current weapons were bouncing off the enhanced armor (they said 14-inch armor plate ... it was more like 12-inch) and asked if we could do something to help. In a matter of 28 days China Lake designed, manufactured and delivered to the Fleet 200 new rockets - the Anti-Tank Aircraft Rocket (ATAR). ATAR was an improved Holy Moses ... a 5-inch rocket (Holy Moses) with a new 6.5-inch conical shaped charge warhead capable of penetrating 15-18 inches of steel.

Between the Korean and Vietnam conflicts, China Lake improved on the basic ATAR design by developing the Zuni rockets ... again the 5-inch basic rocket (with improvements). Zuni came in two different configurations ... air-to-surface and air-to-air. The anti-surface weapons had a 5-inch shaped charge warhead (notice the extended nose) while the air-to-air version had a blast frag warhead. Air-to-surface Zuni performed well in Vietnam but the air-to-air version was less effective. Moving targets (fighters) are hard to hit when the fire control system (located in the aircraft) must predict the position where the target will be during missile time of flight. This problem caused Dr. McLean to ask, 'Why not improve the performance by putting the fire control in the missile?' So 5-inch Zuni was mated to the IR guidance and became the 5-inch Sidewinder.

The 5-inch missile of WWII (with improvements in materials, grain designs, warheads and other improvements) became the standard size missile for many China Lake projects and, after multiple improvements remains the rocket motor for the Sidewinder missile after 60-years.