Shoulder-Launched Munitions

R&D transformation and infantry fighting again

by Kevin Gessner

In September 1915, nearly 6,000 French infantry, advancing with rifles and bayonets, disastrously failed to overcome German positions with machineguns.[1] Almost a century later, a Marine used a shoulder-launched munition to destroy a fortified building held by Iraqi insurgents with automatic weapons.[2] Shoulder-launched munitions transformed infantry fighting.

Today these munitions are being transformed by research and development (R&D), particularly at the Naval Surface Warfare Center Explosive Ordnance Disposal Technology Division in Indian Head, MD. Future shoulder-launched munitions will likely have capabilities orders of magnitude greater than today's. And as these munitions change, so again will infantry fighting.

On a Dock at Indian Head, February 1942

Prior to shoulder-launched munitions, infantry personnel had a limited target set. In World War I, GEN John J. Pershing, USA, stated, "The rifle and the bayonet are the principle weapons of the infantry soldier."[3] Essentially, these weapons limited infantry personnel to mostly engaging opposing personnel.

However, some envisioned infantry with rockets, delivering high explosives. Proposing them to the U.S. Army, the father of modern rocketry, Dr. Robert Goddard, launched rockets using a tube on a music stand in Aberdeen, MD, days before World War I ended.[4] In the 1920s, Dr. Goddard continued developing rockets at the Indian Head naval facility, where rocket research had started prior to the war, and where Army COL Leslie Skinner and 1LT Ed Uhl pursued man-portable rockets in the early 1940s, when such a thing seemed impossible.[5] [6] By comparison, an individual holds a firearm, triggering a rapid combustion of propellant, accelerating a projectile. But holding a launching rocket was another matter.

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Need created urgency. Rockets were increasingly viewed as necessary for countering German tanks. Seeing a 5-foot pipe in a scrap pile behind his Indian Head workshop, 1LT Uhl got the idea for a stovepipe-like shoulder-mounted launcher, allowing a rocket's blast to exit the back end, away from the user. On a dock at Indian Head in February 1942, Uhl fired a prototype man-portable rocket into the Potomac River.[7] More tests followed. By October 1942, 37,000 rockets had been produced, and by World War II's end, 500,000 had been made.[8]

"Today we know the weapon as the bazooka and its introduction gave American infantry the unprecedented ability to fight against German tanks," wrote Dan Ward in his 2005 book, *The*

2d Lt. Edward G. Uhl demonstrates the first bazooka prototype. Cobbled together from a length of discarded pipe, a wooden rifle stock, and homemade hand grips, it outperformed the spigot mortars developed by munitions manufacturers. *(National Archives)*

The first bazooka prototype was made with parts found at Indian Head. *(Photo courtesy of the National Archives.)*

Radical Elements of Radical Success.[9] It was not an auspicious introduction. It had a high dud rate, did not penetrate German Panther tanks' hulls, and was inaccurate at distances. But, in the hands of infantrymen willing to maneuver for side and rear shots, bazookas did kill German tanks.[10]

Essentially, the shoulder-launched munition widened the infantryman's target set. On Saipan, Marines used bazookas to stop Japanese tanks. On Peleliu, one Marine with a bazooka destroyed a Japanese 75mm gun and crew. On Iwo Jima and Okinawa, Marines with bazookas attacked fortified positions, to include pillboxes.[11]

Shoulder-launched munitions spread. Using bazookas captured in North Africa, Germany developed the more powerful Panzerschreck.[12] Based on U.S.-loaned bazookas, the Soviets developed the ubiquitous rocket-propelled grenades, now made in over 40 countries.[13] Today, 70 other infantry-launched munitions are produced by some dozen countries.[14]

Infantry small arms have critical roles, but their rounds have improved marginally. "Soldiers who stormed up San Juan Hill in 1898 carried rifles whose range and muzzle velocity were comparable to those of weapons carried by Soldiers today," wrote Army MAJ Benjamin D. Huebschman in 2012.[15] They also may have little room for improvement. "It's now obvious that you can't get much better performance from a bullet-type rifle," said head of a 1990s Defense Department study seeking the M16 rifle's replacement.[16]

Yet, shoulder-launched munitions—particularly those firing rockets—have changed significantly, and in doing so, changed how the infantry fights, becoming the "infantry platoon's highest casualty-producing organic weapons when used against armored enemy vehicles" (as stated in *FM 3–21.8*). Shoulder-launched munitions were also adapted for attacking field fortifications, bunkers, lightly armored vehicles, and wall breaching.[17] They also eventually enabled individuals to attack aircraft.[18]

These changes in shoulder-launched munitions came largely from the R&D of energetic materials, which are energy-releasing materials, like propellants, pushing munitions to targets, and explosives, producing intended target effects. This R&D rapidly modifies energetics for changing needs and develops new energetics, giving munitions new capabilities—roles that were critical in providing shoulder-launched munitions for Afghanistan and Iraq.

The SMAW employed during a combined clearing mission in Afghanistan. *(Photo by Sgt Mark Fayloga.)*

The Infantry's Target Set Widens

In March 2002, U.S. aircraft dropped a 2,000-pound enhanced-blast bomb, creating heat and overpressure, attacking al-Qaeda and Taliban in the deep and winding caves of Gardez, Afghanistan.[19] Its PBXIH–135 aluminized high-explosive was rapidly developed by the Naval Surface Warfare Center Indian Head Explosive Ordnance Disposal Technology Division, a Department of Defense Energetics Center.

The Marine Corps approached Indian Head, urgently needing an enhanced-blast, shoulder-launched munition for anticipated urban fighting in Iraq. In infantry hands, such a munition would be more responsive and accurate than artillery- and air-delivered munitions. Also, Marines learned from Chechen commanders who had fought Russian forces in Grozny, Chechnya, that "heavy-blast" direct-fire weapons were a must for urban warfare.[20]

Within 9 months, Indian Head developed the "novel explosive" warhead for the shoulder-launched multipurpose assault weapon (SMAW-NE), which included developing the warhead, fuzing, system safety, and testing. It also included manufacturing the first 3,000 warheads. In the 2004 Battle of Fallujah, Marines used SMAW-NEs to attack fortified insurgent-held buildings. Upon detonation, the munition disperses a cloud of combustible material that is ignited. Unlike fragmentation munitions, the novel explosive produces devastating heat and overpressure in a room, as well as in adjacent rooms and hallways. About 1,000 SMAW-NE rounds were used in Fallujah.

The SMAW-NE further widened the infantry's target set and reduced its risks. It provided antistructure and antipersonnel capabilities. One round disintegrated a large one-story masonry building.[21] SMAW gunners eventually knew which wall to hit, causing roofs to collapse, thus Marines often avoided the bloody task of clearing enemy strongholds.[22] "This round saved U.S. lives in house-to-house fighting," wrote former-Commandant, Gen Michael Hagee.[23]

But, Marines needed even smaller and lighter shoulder-launched munitions. The SMAW's weight exceeded

A SMAW in action. *(Photo courtesy of NavSea/Indian Head/site images.)*

30 pounds, and it is 4 1/2-foot length when loaded made it unwieldy. Also, because of its dangerous backblast in confined spaces, SMAW teams often had to move to open areas to fire, exposing themselves to enemy fires.

In recent years, the smaller, lighter light antiarmor weapon (LAW) has been upgraded to provide additional warhead and propulsions options to battlefield commanders. Government and industry experts improved the Vietnam-era LAW. The LAW is a quarter of the SMAW's weight, 16 inches shorter, and only a fifth of its cost. R&D gave the LAW new capabilities, including:

- *Ability to attack more targets.* The previous LAW had limited success against gun emplacements, buildings, and light vehicles. Advances in energetics provided new LAW warheads for:
  - Antistructure: Penetrating and detonating in concrete, brick, and sandbag structures;
  - Antipersonnel: A scaled-down SMAW-NE capability for attacking personnel in structures;
  - Antiarmor: Increased penetration; and
  - Antivehicle: Fragmentation behind light armor and in infantry fighting vehicles.
- *Extended effective range.* The old LAW's maximum effective ranges were 165 meters against moving targets and 200 meters against stationary targets. The new LAW's maximum effective range is 220 meters against all targets, enabled by a higher-velocity rocket motor.
- *Enhanced safety.* In the event of fire—a concern when vehicles hit improvised explosive devices—a rubber-based fire-stop material in the explosive prevents detonation for more than 30 minutes.

The rapid fielding of the improved M72A7 LAW was also enabled by Indian Head's in-house manufacturing, producing 12,000 warheads annually. Today it is used by American, Australian, Canadian, and United Kingdom forces. The improved LAW increases the infantry squad's firepower because several squad members can carry it.

Another improvement follows. The next LAW, the M72A9, has a larger 4-pound thermobaric warhead. Also, fuzing will give it options for detonation on impact or penetration, then detonation in targets such as vehicles.

Things to Come

"Imagine if enormous firepower were concentrated in the hands of single individuals," wrote George and Meredith Friedman in their 1996 book, *The Future of War.*[24] Small unit personnel have already needed such firepower. In Fallujah, small units operated in narrow streets and dense housing, which did not allow tank access or timely and accurate fixed-wing air support.[25] In Afghanistan, platoons divided into small units spread over large areas where bad weather delayed air support and mountains restricted indirect fires. Consequently, returning Marines recommended small units have increased weapons lethality.

In the future, small units will need greater lethality for more lethal enemies. Enemy indirect fire by precision-guided munitions already being sold by some nations will require wide distribution of U.S. small units to reduce target profiles. As they disperse, they will likely face enemies with highly lethal direct-fire munitions. Today, for example, rocket-propelled thermobaric rounds are made and sold by China, Russia, and others.[26] [27] [28] Accordingly, the Office of Naval Research has made "increased small unit weapon lethality" a science and technology objective.[29]

Ongoing R&D has the potential to give shoulder-launched munitions this "enormous firepower, concentrated in the hands of single individuals," and thus increased small unit weapons' lethality. This is especially likely when "working outside the box." Recent R&D mostly improved existing munitions, which have limits. New designs, starting with a "blank sheet," would allow more flexibility for incorporating many new technologies, possibly leading to 10 times performance improvements. Such improvements and enabling technologies include:

- *Increasing ranges.* Afghan insurgents engaged with rocket-propelled grenades and medium machineguns ranging 920 to 1,000 meters, knowing that most U.S. infantry weapons have effective ranges of 500 meters. Thus, U.S. forces have sought longer-ranging shoulder-launched munitions that are more responsive than mortars, artillery, and/or air support.[30] The Indian Head-developed enhanced impulse propellant, using inert tungsten to reduce backblast, provides options for future munitions, including increasing ranges. Two-stage rockets may also increase ranges.
- *Multipurpose munitions.* Present shoulder-launched munitions each have different functions, such as bunker-busting, building-busting,

antiarmor, etc. One round could eventually do several functions, to include attacking aircraft, thus increasing tactical flexibility and reducing logistics. Warhead design and fuzing could enable multipurpose munitions.

• *Precision Munitions.* R&D is reducing the size and cost of guidance technologies that are being incorporated into mortars for testing. The integration of guidance systems into shoulder-launched munitions can be facilitated by using space-saving "micro-electro-mechanical systems" for fuzing. These dime-sized systems are smaller, lighter, cheaper, and more reliable than present fuzes, and have been integrated into the 40mm grenade. They are developed in the country's only energetics-certified micro-electromechanical system development labs concentrating on silicon-based structures at Indian Head.

• *Smaller, lighter munitions.* This is a priority for infantry, as some have carried 97- to 135-pound loads in Afghanistan.[31] Conceivably, 20mm, 30mm, and 40mm caliber munitions could have significant capabilities. The following technologies could help smaller munitions "punch above their weight":

- Replacing present propellants with improved propellant, providing the same impulse at half the weight; and
- Replacing present fuzes with smaller microelectromechanical system fuses, making room for more explosives and propellant.

• *Reduced logistics.* This would result from smaller and lighter, thus more transportable munitions than today's. It also might result from fewer munitions needed for targets because of increased precision and lethality. And, multipurpose munitions—one round for several different types of targets—would reduce and simplify logistics.

Shoulder-launched munitions with such enormous, concentrated firepower would be an enabler for the Marine Corps' *Concept for Distributed Operations*, which calls for widely dispersed small units to use "enhanced direct-fire capabilities," as well as supporting arms to "destroy much larger hostile forces."[32] At the same time, the *Concept for Distributed Operations* states that small unit "dispersion beyond the range of mutual support with direct-fire weapons is a potential source of increased vulnerability."[33] Improved shoulder-launched munitions enhance small units' direct-fire capabilities while helping reduce their vulnerabilities from dispersion.

A 200-Year-Old Vision Still Unfolding

In 1806, British Army COL Sir William Congreve tried to improve rockets he had seen in India, but in doing so, set fire to the city of Boulogne. Afterward, he tried to justify his endeavor, saying, "The rocket is, in truth, an arm by which the whole system of military tactics is destined to change."[34] Some 136

years later on a dock at Indian Head, Congreve's vision began to be realized in the form of shoulder-launched munitions, thus changing military tactics. R&D is still changing these munitions, promising even greater changes for tactics, and proving Congreve correct for a long time to come.

Notes

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>Editor's Note: For more on shoulder-launched munitions, go to http://bit.ly/1avpz3A and http://bit.ly/1avpz3A. These videos contain raw combat footage and may be unsuitable for some viewers.