Air and Space this Week

Item of the Week

Rockets: Sub to Shore

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[KEY WORDS: "Eugene" "Fluckey" "submarine" "USS Barb" "torpedo" "rocket"]

*This item is motivated by the first Sub-to-Shore **rocket bombardment** in history, 75 years ago, on June 22, 1945*.

I really hate to say this, but it's true. War poses tremendous incentives for technological development. It is also true that war cruelly exposes any deficiencies in technological development. Examples of each follows.

Naval combat, especially in the "olden days," was primarily about sinking the ships of the other guys. Two millennia ago, triremes were fitted with rams, allowing opposing ships to be sunk by simply rowing into them. Shipborne archers would disable rowers and archers on the other side, but there was little such weapons could do to cause sinkings. Then the Byzantines developed "Greek Fire," an incendiary substance that could ignite enemy vessels and crew. Gunpowder followed, and ships began to carry rifles and cannons of increasing lethality. By WWI, ships could mount cannons capable of twenty-mile range. With the development of the airplane, there now was the prospect of attacking ships from above, but getting close enough to be accurate with aerial bombs exposed the attacking planes to defensive fire.

While these developments were taking place, an anti-ship weapon of a different type was envisioned. The very first submarine attack occurred in the American Revolution, when brave Sergeant Ezra Lee piloted David Bushnell's invention, the "Turtle" on September 6, 1776. The British were blockading New York, and there was no way for the Revolutionists to break the blockade, since the blockading ships had strong defenses. Lee's mission was to (mostly) submerge, approach *HMS Eagle*, one of the blockaders, and attach a bomb to its hull with a screw Lee could affix from inside the *Turtle.* Alas, the attack failed, but the idea of using explosives against the hull of a ship remained.

The next step in this evolution was to combine the idea of ramming an enemy ship with the use of explosives to rupture its hull. The simplest form of this was the "spar torpedo," a bomb on a stick that would be rammed against an enemy ship's side and detonated. [The torpedo weapon was named for the common torpedo, a species of electric ray found in the Mediterranean Sea eastern Atlantic. The name was originally also applied to stationary explosives, what we would call "mines" today – hence the famous dictum, "Damn the torpedoes, full speed ahead!"] As you might guess, attacking a ship with a bomb on a stick was almost as dangerous to the attacker as it was to the attackee. But it did work; for example, the Confederate submarine,

Hunley, sank a Union blockading ship off Charleston, the *USS Housatonic*, but was itself lost in the aftermath of the attack.

But "wooden ships turned to iron, and iron ships to steel" (quote), and an arms race of sorts developed between ship and weapon designers during the pre-WWI era. Ship firepower became too great for ships to get close to one another and blast away as they did in the days of sail. Longer range cannons was one answer, but accuracy suffered greatly from increasing range. A weapon was sought that could carry an explosive charge to the side of an enemy ship, reliably and relatively safely to the attacker. Inventor Robert Fulton created what he called a "torpedo," a towed explosive charge that his *Nautilus* submarine could drag to impact an overhead warship.

A better solution, in time for WWI, was the self-propelled torpedo. A miniature non-crewed submarine, this kind of torpedo contained an explosive charge that would explode on impact, an ingenious steam engine, and mechanisms for making the torpedo go straight at a depth set by the firing crew. Crude self-propelled devices had been used as early as the Crimean War (1855). But the torpedo wasn't a practical weapon until British engineer, George Whitehead, developed a propulsion system that involved spraying a mist of water into a flame fed by alcohol and stored compressed air, with the resulting steam expansion then turning a turbine which drove the propellers. The basic Whitehead design lasted through WWII.

Larger cannons firing shells of increasing size and power, and the development of the Whitehead type torpedoes, were balanced against heavier and stronger side armor, at least for capital ships, in the naval competition of the day. But a battleship was hard-pressed to carry that much additional weight, so guns and side armor prevailed over armoring all of the battleship hull. But the side armor was enough to defend against both shell and Whitehead.

But what if attackers could cause an explosion *beneath* the battleship, where the armor is thin or non-existent, rather than against its side armor? Such a blast would almost certainly break the keel of any warship, and likely sink it outright.

That was the motivation for the development of the magnetic torpedo exploder. The idea was to send the torpedo beneath the larger target, and have the magnetic field of the steel hull detonate the explosive where it could do the most harm.

The naval arms race was expensive for all involved, so the idea of using (relatively) cheap torpedoes against targets with extremely expensive armor became quite attractive. But this was happening during the world-wide Great Depression, so even "cheap" weapons were difficult to procure. A few torpedoes with magnetic exploders were built, but they cost about $10K apiece, an enormous expense in 1930 dollars. So very little testing was done on the exploder in the lab, and none was done under relatively realistic conditions.

Look, a torpedo of that era is a simple weapon. It has to do only four things reliably: run, go in the direction aimed, run at the depth specified, and go "boom" upon arrival at its destination.

The torpedoes the U.S. Navy had to use for the ***first two years of the War*** could not do all four of those things reliably. They couldn't do three of those things. Or even two. The proven,

WWI-era Whitehead propulsion system worked well (but their propulsion combustion generated a heavy trail of bubbles that could warn the target and guide its defenders to the sub). Our torpedoes did not run as straight as they should (a problem), they ran significantly deeper than set (which made the contact exploder many were fitted with useless), and neither their contact or magnetic exploders worked properly (disastrous!).

The Bureau of Ordinance was little help. What would eventually save the day was an innovative approach to finding and solving the many overlapping defects of this flawed weapon. That, and the need for realistic testing, testing, testing are the key take-aways here.

The story of our lousy torpedoes has been covered in vastly more detail elsewhere, and while the bare-bones explanation above is generally accurate, there are a lot of underlying circumstances here (local politics played a big role in Interwar weapons development, some involved became too personally-invested to be able to make good decisions, etc.). In some cases, one deficiency would mask another, so fixing each was sequential, not simultaneous. An example is torpedoes running too deep to activate magnetic exploder, which functioned properly only part of the time, anyway.

ComSubPac "Uncle Charley" Lockwood aggressively shook loose the system in 1943. He ordered live torpedoes to be fired at fishing nets hung in rows; holes in the nets showed how deep the torpedoes were running during their run. Magnetic exploders were tested rigorously, in spite of the heavy secrecy that had surrounded them earlier in the War, and found to have been inadequately designed and tested. Tests on the magnetic fields around ships failed to take into account the effect of the magnetic latitude of the ship's location (*e.g.* the area around the ship in which its magnetic field was strong enough to activate the exploder was shallower than expected in the areas most Pacific subs operated). But the magnetic exploders did seem to function some of the time. [The situation was so bad, that one source even rumored that the original design of the American magnetic exploder had been stolen from the Germans in the 1930's, but that the Germans had allowed the theft, and the plans were good enough to be believed, but had been altered to fail.] Both Germany and Britain had experimented with magnetic exploders in WWII, but did not use them in combat, relying instead on contact exploders of reliable design.

After Dan Daspit on the *Tinosa* fired a dozen duds at an important target, it was clear that the contact exploders were no good, either. Daspit brought one of his torpedoes back home for inspection, but no obvious defect was found. Lockwood then ordered a live firing test against a submerged cliff. The first torpedo exploded normally. Depending on the account, so did a second. In either case, the next torpedo was a dud. Now came the fun part, a soon-to-be-decorated diver went down and shackled a line to the torpedo, which was then hoisted aboard for examination. The exploder's firing pin was supposed to, upon impact, be driven by a spring to swing between two guides, *perpendicularly to the torpedo's motion*, to strike the detonator cap, setting off the warhead. The dud torpedo's exploder, when inspected, showed that the impact had crumpled the nose of the torpedo, damaging the guides, before the pin could strike the cap.

Lockwood had also ordered the building of a contact exploder testing rig, consisting of a cable slung from a large crane, down which an exploder could be dropped against a steel plate target. Testing of the existing contact exploders quickly showed that torpedoes hitting the plate perpendicularly (i.e. an ideal torpedo shot) almost always failed, with damage akin to that from the live-fire test. However, if the plate were tipped so that the exploder hit it at a shallow angle, the exploder would work almost every time.

A lot of subs were on patrol when this was worked out. How'd you like to have been a combat sub skipper and get the word from the home office that your torpedo wouldn't work unless you aimed at the "turn of the keel" or for a glancing hit?

Now that the problem had been revealed, solutions were sought on a number of fronts. Drop tests were conducted with stronger springs and or lighter firing pins to make the pin swing faster, or with a pin that didn't have to swing transversely at all. The depth control problem was fixed, but the magnetic exploder proved to be too fragile to be made to work correctly with the prevailing technology of the day, so it was (temporarily) abandoned. By the start of 1944, U.S. subs went on patrol with torpedoes that worked. Jasper Holmes said, in *Undersea Victory*: "In this "experiment" (referring to Dan Daspit's attack on *Tonan Maru #3*), carried out in enemy waters, with the unwilling cooperation of a big Japanese tanker, Daspit pretty well proved that the contact exploders were defective. It might have better been done at Newport (then the only U.S. torpedo manufacturing plant), where observation could have been taken on the target, and the torpedoes examined after their runs, and it should have been done before any submarine or destroyer went to sea armed with such torpedoes, to do battle with the enemy."

Others, including sub captain Freddie Warder, expressed their opinion of the torpedo situation in significantly earthier terms.

I believe that there are two general types of wartime leaders: fighters and administrators. This is a variation on the old adage that "Captains talk tactics while Generals talk logistics." Admiral Halsey was a good example of a fighter. When our backs were against the wall at Guadalcanal, Halsey's boldness saved the day. But by the War's end, the needs of sound logistical management eclipsed those of fighting in tough scrapes (most, but not all, of the time; see info about the great fighter, Ernest E. Evans, of the *USS Johnston*). An example from the WWII submarine world is Richard H. O'Kane. His entire existence revolved around making the *USS Tang* the most successful sub on the planet, and he succeeded. But after the War, he did not fit the peacetime needs of the Navy, where the primary need was for managers, not fighters.

Ideally, a combination of fighter and administrator (innovator) is best, but such a combination is quite rare. In WWII surface forces, someone like Arleigh Burke arguably fell into the "both" category; In WWII subs, Freddy Warder might be a "both," and Eugene Fluckey certainly was.

Both O'Kane and Fluckey were engineering innovators. O'Kane took his sub far beneath its test depth during its shakedown, knowing that minor leaks and equipment failures would come before the hull imploded. He identified and fixed various fittings and other minor leaks, and found he could safely and routinely dive to 600', far below his test depth maximum. Such testing scared his crew silly, but he had a much better idea of his sub's capabilities before he hit

combat. He also did the little things, such as making sure the construction crew got a couple of scarce hams in return for the installation of non-standard gear, and buying his sub a metronome so that the soundman could determine quickly the rate of a target's propeller rotation, a key to a successful torpedo attack.

Fluckey was as courageous as O'Kane, but in his own quieter way. He trained his crew well, and was always looking for new tactics or weapons he could use to take the war to the enemy.

Japanese shipping was being decimated by submarine attacks, now that the torpedo problems had been solved. They were late to establish a convoy system, but they did do so, and it helped stem their losses. A convoy of supply ships would be escorted from port-to-port, as close to shore as they could safely travel, during the day, and then hole up in port at night. Fluckey figured out the pattern and the harbors being used, and penetrated one full of ship (requiring a very long and dangerous run on the surface before and after the attacks). He sank several ships, and would earn a Medal of Honor for it.

Any skipper in the process of being so honored would normally be removed from combat, but Fluckey had extracted a promise from Lockwood that he could have one last "graduation" patrol. He scoured the base for equipment, and Lockwood told him to "raise a ruckus" to cover the departure of a sub wolfpack that was to penetrate the Sea of Japan at the same time.

And a ruckus he did raise! Patrolling off Sakhalin, he could see a Japanese railroad running along the coast, with supply and troop trains running often. He had no weapons aboard to do anything about it. Or did he?

Subs carried several 55-pound bombs to be used to scuttle the sub to prevent its capture. He talked things over with some of his chiefs, including one electrician who had worked for the railroads prior to the War. They cooked up a plan to use one of the demolition bombs to blow up a train. A shore party would go in at night, bury the bomb beneath the track, and set an electrical circuit up to detonate the explosive when the train went over it. The electrician had remembered a trick his school chums would do at the railyard near where they grew up. They'd grab some walnuts from a neighbor's tree, then go to the railyard and put the nuts between the rail and a tie. The rails would sag over half an inch under the weight of the train going over, and crush their tough nuts for them. They would use the same idea, with a microswitch from the sub's radarman's stores instead of the nut. A battery to set the explosive off when the microswitch closed was the only other component needed.

This innovation worked like a charm, and the official battle flag of the submarine *USS Barb* has, among the many ship silhouettes it earned, an outline of a train, the only train "sunk" by a submarine during the War. [NOTE: the flag at the top of the material linked to above does not have the train, but scroll down to the flag being shown on the *Barb* – there is another row of symbols on that flag, and the train is "front row-center" on that line.]

This was the first and only invasion of the Japanese home islands during the War. And, needless to say, his attack greatly affected Japanese morale and diverted attention as planned. But Fluckey's graduation patrol was nowhere near over.

Military tactical use of rockets was in its infancy in 1944. We were developing air-launched rockets like the "Holy Moses," "Tiny Tim," and others. Small rockets were being used to extend the range of mortar shells, and were starting to be used on landing craft for close-in support during invasions or to launch grapnel lines for shore defenses like those at Point du Hoc in France.

But nobody had seriously thought about rocketry bombardment from submarines before, until now.

Fluckey had been able to acquire a number of rockets and a large rack from which they could be launched, and on June 22, 1945, he demonstrated the value of such a capability, destroying a number of shoreline shipbuilding and other installations via rocket attack near the wolfpack exit point. He sunk smaller ships by ramming and/or with crew-thrown Molotov cocktails. Ruckus, indeed!

After a fine career in the Navy and afterward, Fluckey retired to northern Virginia. He passed away on June 28, 2007.

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Fluckey

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Submarine Warfare in WWII

Charles A. Lockwood wrote many books about WWII submarines – see *Sink 'Em All: Submarine Warfare in the Pacific*, 1951, hard to find except in various post-1951 paperback editions

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AVIATION NEWS

COVID-19: The biggest news in the aviation world continues to be the impact that the COVID-19 pandemic is having on airline travel. The entire industry and its associated supply lines are suffering (*e.g.* see several articles in the current *Aviation Week* website). See the following for the latest COVID-related and other aviation news:

Commercial: https://www.flightradar24.com/blog/latest-coronavirus-airline-and-aviation-industry-news/; https://www.aviation24.be/category/miscellaneous/covid-19/; https://www.internationalairportreview.com/topic_hub/covid-19/

General: https://www.aopa.org/news-and-media/all-news/2020/march/16/latest-news-coronavirus-impact-on-ga (Ignore the March 16 date in the URL, the latest update here is 6/5)

WWII: These two weeks in 1945 saw the B-29 bombing campaign against the Japanese home islands expand greatly, as well as bombing strikes on a number of other targets.

June 8: A large B-29 raid was conducted against Omuta and other cities in Japan. A total of over 3000 tons of bombs were dropped.

June 8: AAF B-24 bombers conduct the longest northern Pacific bombing strike of the War (2700 miles), from Shemya in the western Aleutians to Kruppu in the Kuriles.

June 21/22: The tenth and final massed kamikaze attacks against American naval forces off Okinawa was conducted. Japanese strength was dwindling; only 45 planes were involved. One landing ship was sunk, and there was some other minor damage.

June 22: More than 400 B-29's attacked Kure, Wakayama, and other targets.

June 26: More than 450 B-29's attacked Osaka and other targets.

June 28: More than 475 B-29's attacked Okayama, Sesebo, and Moji.

Last Edited on 8 Aug 2020