The History of the Torpedo and the Relevance to Today's U.S. Navy

By Russell Thomas

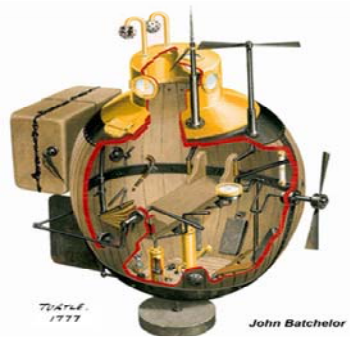
The torpedo is a descendant of the floating mine. To identify the historical track of the torpedo, one must first learn of its different stages of evolution.

The earliest documentation to support the torpedo's first use dates back as early as 1585 by the Dutch, where torpedoes were actually a ship packed with explosives. The ships moored alongside their potential victims. Floating kegs of gunpowder took the place of ships in the Battle of the Kegs at Philadelphia in 1778 during the Revolutionary War. These floating mines were uncontrollable; they had no anchor and drifted downstream with the current. The primary purpose of these weapons was to attack a ship at its most vulnerable point, the waterline.

Early Torpedo Development

The use of the torpedo in the United States dates as far back as 1775. David Bushnell of Connecticut possesses the title of "Father of the Torpedo and Mining Warfare"[1]. His approach to underwater warfare was the beginning of American torpedo and mine warfare. He discovered that gunpowder could be detonated underwater. He designed a one-man submarine boat that would submerge and attach a gunpowder magazine to the hull of a ship.

His submarine boat, the *Turtle*, was not the first submersible craft, but it was the first to employ a weapon. The *Turtle* made its pioneering first attack in 1776 against the blockading squadron of the English fleet in New York harbor. Sergeant Ezra Lee piloted the *Turtle*; his attempt to fasten a 150-lb mine to the hull of Lord Howe's flagship was unsuccessful. Due to monetary constraints, no further improvements came about.



DAVID BUSHELL'S TURTLE

Robert Fulton continued the development of the floating mine in 1797. Fulton's ideas were not intended for wartime use, but to prevent war at sea by rendering the worlds naval fleets obsolete. His first attempt came in 1797 during the French Revolution. The results were questionable. The weapon was a rudimentary locomotive torpedo. After several attempts to persuade the French and Dutch into purchasing the mines, Fulton sold the ideas to the English to use against the French. The French considered his devices of war immoral and indefensible.

It was after many experiments for the British that Fulton realized the notion of the floating mine. In 1810, he perfected the floating mine with a copper case and safety lever for maintenance for the American Navy. These mines, anchored to the ocean floor, could stay in place indefinitely. Robert Fulton's attempts at preventing war did nothing but hasten the world's need to perfect this style of warfare.

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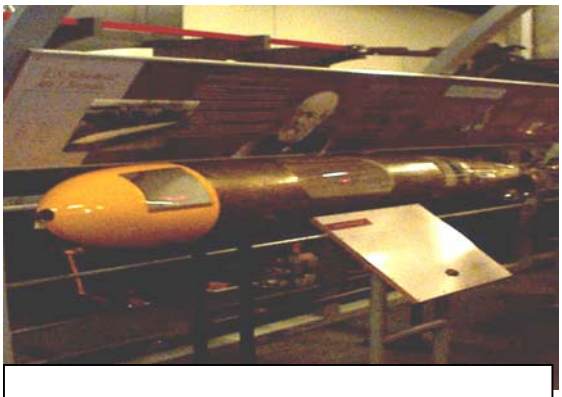
[1] *Mines Minelayers, and Mine laying* by CAPT J.S. Cowie, R.N.

Mine warfare continued to develop throughout the Civil War. The Confederate states used mine warfare extensively to counter the Union ships which greatly outnumbered the southern vessels. A minefield three layers deep defended Mobile, Alabama against a Union maritime assault. The Confederacy made extensive use of Davids', a semi-submersible craft that was powered by hand or steam, to match the muscle of the Union fleet.

The Era of the Automobile Torpedo

Robert Whitehead in 1866 designed the first "automobile" torpedo. It was self-propelled and would attack its target rather than wait for the enemy to come to it. His design was the point from which all other concept designs would begin.

The first Whitehead torpedo used a two-cylinder, compressed air engine that gave it a speed of 6.5 knots for a distance of 200 yards.[2] Whitehead then developed two more models and began selling these weapons to the navies of the world. The first model had a length of 11 feet, 7 inches and a diameter of 14 inches. It weighed 346 pounds and had an explosive charge of 40 pounds of guncotton.[3]



The Whitehead Torpedo on display at the Naval Undersea Museum.

The second model was 14 feet in length, 16 inches in diameter and weighed 650 pounds. This model carried a 60-pound explosive guncotton.[4]

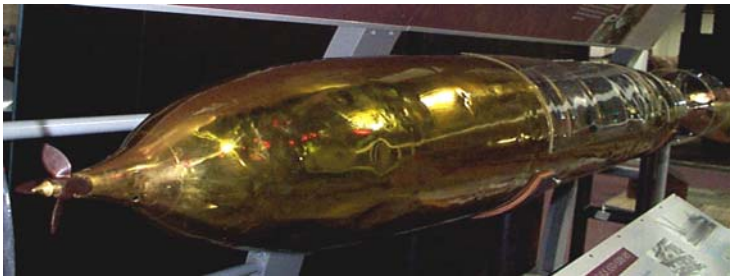
The United States refused to purchase the Whitehead torpedo and made a conscious decision to attempt its own torpedo research and development program.

In 1869, the Navy established a torpedo station at Newport, Rhode Island. The station had the assignment of designing and building a torpedo using the Whitehead scheme, despite its criticized design, as a starting point. What NTS (Naval Torpedo Station) developed was a weapon similar to the Whitehead. It was 12 feet, 5 inches long, with a 14-inch diameter and weighed 450 pounds. It carried 80-90 pounds of guncotton and had a speed of 6-8 knots for a 400-yard range. The torpedo never left the test stage, because the air flask and hull did not maintain watertight integrity; the engine was also flawed. Corrections were made and plans were submitted to the Bureau of Ordnance for production. Only two test torpedoes were ever manufactured. The NTS Fish torpedo program terminated in 1874.[5]

[2-4] *A Brief History of U.S. Navy Torpedo Development* by E.W. Jolie, Naval Underwater Systems Center, Newport Laboratory

[5] *Submarine Review April 1996-Torpedoes through the Thirties* by Frederick J. Milford

The Howell torpedo, (shown below) the first successful torpedo development program by the U.S. Navy, began in 1870. Lieutenant Commander John A. Howell created a torpedo driven by a 132-pound flywheel that spun to 10,000 revolutions per minute. A steam turbine housed on the torpedo tube spun the flywheel before launch.[6] The Navy only produced 50 for tactical use.[7]



The Howell Torpedo on display at the Naval Undersea Museum.

The Howell torpedo remained in service until 1896 when the United States decided to purchase the Whitehead and Bliss-Leavitt torpedoes. The United States purchased the Whitehead torpedo out of fear of falling behind in the world. Almost all other nations owned some version of the Whitehead torpedo.

The Whitehead and Bliss-Leavitt torpedoes made up the torpedo arsenal of the United States Navy from 1896 through 1910. The Whitehead Mk 1, 2, 3, and 5 and the Bliss-Leavitt were the primary workhorses for the Navy. The Whitehead Mk 1 and Mk 2 versions came in both 3.55 meter (11 feet, 6 inches) and a 5-meter (16 foot) length. The 5-meter Mk 1 carried a 240-pound warhead, which at that time was the biggest payload on a torpedo. The 5-meter also had a gyro for azimuth control. The Whitehead Mk 3 was only 3.55 meters in length but was equipped with the Obry gyro.

The Mk 1, 2, and 3 Whitehead torpedoes to this point were cold running weapons. Cold running meant that the weapon operated on compressed air. The invention of a "super-heater" produced the hot running torpedo; this device used a combustion pot to heat the compressed air to enhance performance. The Whitehead Mk 5 operated on this concept.[8] The Mk 5 ran to a distance of 4000 yards at a speed of 27 knots. The speed and distance of the weapon could change by varying the amount of heat to the flask. The Bliss-Leavitt Mk 1 operated on a 2250-psi (pounds per square inch) air flask with a super-heater that could produce a speed of 27 knots for a range of 4000 yards.[9]

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[6] *Brief History of U.S. Navy Torpedo Development* by E.W. Jolie, Naval Underwater Systems Center, Newport Laboratory

[7] *Submarine Review April 1996-Torpedoes through the Thirties* by Frederick J. Milford

[8] *The Devil's Device- Robert Whitehead and the History of the Torpedo* by Edwyn Gray

[9] *A Brief History of U.S. Navy Torpedo Development* by E.W. Jolie, Naval Underwater Systems Center, Newport Laboratory

Warhead Modifications

From 1910 to 1915 there were as many as ten modifications to the "war noses" or by today's definitions, detonators. The modified Whitehead exploders went from a direct impact exploder to a model that would detonate from any direction or glancing blow to a hull by the use of whiskers; four levers which actually extended from the warhead. Upon any slight jolt of a glancing blow, the whiskers would release the shear pin and allow the firing pin to impact the percussion cap, detonating the warhead. These war noses remained in use until 1922 when the Whitehead and Bliss-Leavitt torpedoes were retired from service. The Navy began utilizing the ACR feature (Anti-Circular Run) around 1911. The ACR, initially a segment of the exploder mechanism, is currently incorporated into the torpedo course gyro. This feature prevented warhead detonation by sterilizing the exploder if the weapon turned 110 degrees from its original course[10].

Torpedo development during the World War I was minimal. An electric torpedo design was scrapped before the program ever got off the ground. The Whitehead and Bliss-Leavitt Mk 6 torpedoes were all removed from service in 1922. The remaining U.S. Navy torpedo arsenal consisted of only the Bliss-Leavitt torpedoes Mk 7, Mk 8, Mk 9, and Mk 10. The Mk 7 torpedo was the first steam-driven torpedo for the U.S. Navy. The Mk 7 had a range of 6000 yards and a speed upward of 35 knots. It was 18 inches in diameter and could be fired from both destroyers and submarines. The Mk 8, Mk 9, and Mk 10 had a diameter of 21 inches. The Mk 8 was a destroyer-fired weapon. The Mk 9 and 10 were submarine-fired weapons. In the early 1920's, the U.S. discontinued its contractual agreement with the Bliss-Leavitt Corporation citing a patent rights dispute over the Mk 9 torpedo. The Navy then made the Newport R.I. weapons station the sole point for United States development, design, and research of underwater warfare.

World War II and the Electric Torpedo

The post World War I/pre World War II era defined the modern torpedo. The first American airdrop torpedo test was conducted in 1920. Three weapons stand out from that era. The Mk 13, the aircraft launched torpedo, was a 13 ½ feet long torpedo with a range of 7000 yards and a speed of 30 knots.[11]

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[10] *A Brief History of U.S. Navy Torpedo Development* by E.W. Jolie, Naval Underwater Systems Center, Newport Laboratory

[11] *A Brief History of U.S. Navy Torpedo Development* by E.W. Jolie, Naval Underwater Systems Center, Newport Laboratory

The Mk 14 torpedoes deployed from submarines. The Mk 14 is responsible for sinking over four million tons of Japanese shipping during World War II.[12]

A Mk 14 Torpedo on display at the Naval Undersea Museum.

The Mk 15, the destroyer-fired torpedo, had an 825-pound warhead and remained in service until the 1950's when 21-inch torpedo tubes were removed from destroyers. [13] The United States and allied forces utilized these three weapons extensively during World War II. [14]

Around 1941, upon successful seizure of the U-570 by the British, the United States began designing an electric torpedo to copy the Germans' latest technological advancement.

A German G7e on display at the Naval Undersea Museum.

The Mk 18 torpedo was available for fleet use within a year of the capture of its German predecessor. The electric torpedo had a battery compartment instead of an air flask. An electric motor replaced the engine, but pneumatic controls remained because of their tested reliability. The electric torpedo had two distinct advantages: the weapon was wake-less. It did not warn of an attack or a location from which it was launched and it required less manufacturing effort. The World War II electric weapons used a lead acid battery that required maintenance often. This proved to be a problem for the submarine fleet; hydrogen would expel during the maintenance process or by self-discharge. Purging the torpedo room on a regular basis was required.

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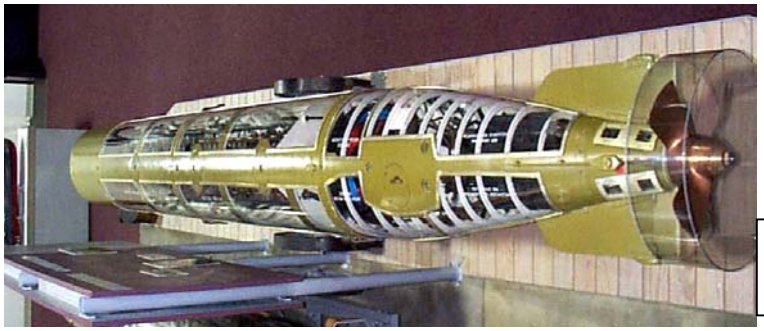
[12] *A Brief History of U.S. Navy Torpedo Development* by E.W. Jolie, Naval Underwater Systems Center, Newport Laboratory

[13, 14] *Submarine Review April 1996-Torpedoes through the Thirties* by Frederick J. Milford

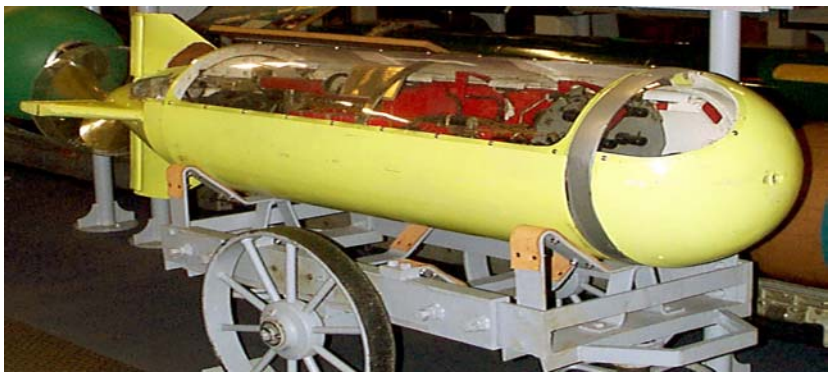


A Mk 18 Torpedo on display at the Naval Undersea Museum.

The Homing Torpedo

An idea to develop a weapon that "attacks what it hears" originated during World War II. The theory is that the weapon would home in on an underwater noise such as the propeller of a destroyer. The weapon would then arm and attack the source of the noise. This concept of a homing torpedo had its drawbacks. A submarine sitting on the bottom of a harbor or a ship moving slowly would be quiet, making it difficult for a homing weapon to find its target. The Office of Scientific Research and Development and its subsidiary the National Defense Research Committee had complete control over this project.[15]

They developed the Mine Mk 24. The term mine was to mislead enemy intelligence. The Mk 24, nicknamed "Fido", was a small, stubby torpedo with an electric motor. A conscious decision to design a weapon that was not extremely fast (10-12 knots) was made considering its prey, a submerged enemy submarine, would only travel at a speed of 3-5 knots.[16] Fido was airdropped with a 10-15 minute run time on a 48-volt battery. The Mk 24 was responsible for sinking approximately 15 percent of enemy submarines sunk by air escorts from 1943 through the end of the war.



The Fido Mk 24 Mine on display at the Naval Undersea Museum.

[15] *Submarine Review April 1997- WWII Development of Home Torpedoes* by Frederick J. Milford
[16] *Hellions of the Deep- The Development of American Torpedoes in WWII* by Robert Gannon

The Mk 27 torpedo, nicknamed "Cutie", was developed late in the war. The Cutie was a modified Mk 24 that was launched from a submarine. The Mk 27 was the first torpedo to leave the tube under its own power. It swam out; other torpedoes were fired by a charge of compressed air. The Mk 27 proved useful in the Pacific by hunting down sampans that were tracking Allied submarines near the coastlines.

GE (General Electric) was in development of an active homing torpedo design. This torpedo would be released to run at a certain depth, speed, and course. The weapon itself would go active and search for its own target using echo- ranging, the sending and receiving of sound waves through the water. The enemy must then maneuver to avoid it because active homing torpedoes, unlike the passive torpedoes were not easily distracted by counter-measures or ocean noise. The Mk 32 active homing torpedo passed the test phase in 1944 but the program never saw production until brought back in 1951 as the Mk 32 Mod 2 for ASW (Anti-Submarine Warfare) development.

Anti-Submarine Warfare and the Mk 46 Torpedo

By the end of World War II, the United States had seven torpedoes in active service with twenty-four in design and development. Most of the weapons in the design and development stage never acquired active service stature. Torpedo research turned from attacking surface vessels to focusing on anti-submarine warfare. Technological advancements in sonar systems allowed the United States to detect an enemy submarine at a greater distance than it had a weapon capable of attacking it. This led to the development of the "thrown torpedo" in the early 1950's. It would be used in ASW to prevent enemy submarines from coming too close to ship convoys or to ports of United States naval vessels. This was the initial format from which the ASROC (Anti-Submarine Rocket) was based on. In 1956, the program to build the ASROC started. A direct descendant of the RAT (Rocket Assisted Torpedo) program of 1953, the ASROC program became operational in 1962 with a Mk 44 torpedo as the initial payload of an intermediate-range missile fired from a launcher on a destroyer. The Mk 46 torpedo replaced the Mk 44 as the payload of the ASROC during the mid 1960's.

A Mk 46 Torpedo being launched.

The MK 46 Mod 5 is the most recent U.S. Navy destroyer-launched ASW weapon capable of being fired from surface vessel torpedo tubes or from the ASROC. Designed for a rapid response, all weather delivery, the Mk 46 is 16 feet in length and has a search range of over 3000

yards and depths of 1500 feet. [17] The Mk 46 ASROC classifies as an intermediate range ASW weapon. It is the currently employed standard NATO lightweight torpedo.[18]

The Submarine Launched Mk 48 Torpedo

The Navy experimented in the 1950's and early 1960's with a wire guided torpedo as well as a torpedo that would run a set pattern or would zigzag to its potential target. Both concepts became obsolete with the development of the Mk 37, the first successful U.S. wire-guided, active homing ASW weapon. The Mk 37 had an acquisition range of 1000 yards and a maximum speed of 24 knots. It could find and attack a submarine down to 1000 feet. [19]

In the 1950's, submarines acquired nuclear propulsion and became capable of speeds of well over 20 knots submerged. The Navy needed a faster torpedo to hunt down faster submarines. The Research Torpedo Re-Configuration (RETORC) program began in 1956 to develop faster and more accurate torpedoes than the Mk 37. The Mk 45 was delivered to the fleet in 1963. It had a speed of 40 knots and a range of 11,000 to 15,000 yards. The payload of the Mk 45 was a nuclear warhead. The Mk 45 had a seawater-activated battery with no homing capability. The detonation command via wire guidance satisfied the requirement of positive control.[20] The Mk 45 tenure ended in 1976 with the non-nuclear Mk 48 replacement.

The Mk 48 torpedo is wire-guided, acoustic homing weapon built to cover long distance at high speed. Development began in 1963 as part of RETORC II and the Mk 48 was released to the fleet in 1971. Today the Mk 48 is the primary active service torpedo in the United States submarine arsenal. The Mk 48 has seen several modifications since 1971. The latest generation is the Mk 48 ADCAP (Advanced Capabilities), which has been in production since 1989. The Mk 48 ADCAP is carried onboard all U.S. submarines and can be operated with or without wire guidance. It has a length of 19 feet, weighs approximately 3500 pounds, and carries 650 pounds of high explosive.[21] It can be active or passive homing with a range greater than 5 miles. It can hunt down deep submerged contacts in excess of 1200 feet. Using a target search, acquisition, and attack procedure the Mk 48 can also re-attack its target if it misses.

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[17] *www.chinfo.navy.mil/navpalib/factfile/weapons/wep-torp.html* General Characteristics of the Mk46, Mk-48, Mk-50 torpedoes and the ASROC Mk 46 Mod 5
[18] *Submarine Review October 1997- Post WWII Launched/ Lightweight Torpedoes* by Frederick J. Milford
[19] *Submarine Review July 1997- Post WWII Submarine Launched/Heavy weight Torpedoes* by Frederick J. Milford
[20] *Submarine Review July 1997- Post WWII Submarine Launched/Heavy weight Torpedoes* by Frederick J. Milford
[21] *www.chinfo.navy.mil/navpalib/factfile/weapons/wep-torp.html* General Characteristics of the Mk46, Mk-48, Mk-50 torpedoes and the ASROC Mk 46 Mod 5

The Mk 50

The Navy began development of the Mk 50 torpedo, nicknamed Barracuda, in 1972 when the Soviets introduced the Alpha submarine, a high-speed deep diving threat. The Mk 50 is steam-driven using an exothermic chemical release to produce steam. Its SCEPS (Stored Chemical Energy Power System) idea is not new. The Navy experimented in the 1920's with chemical energy but terminated the program. The Applied Physics Laboratory at Penn State University revitalized the research.[22]

The Mk 50 being deployed.

It is part of the Navy's Advanced Lightweight Torpedo program. The Mk 50 is dropped from an ASW plane, helicopter, or launched from a surface combatant. The Mk 50 is only 9 feet long and weighs 750 pounds. It has a speed in excess of 40 knots and a range of 20,000 yards. The Mk 50 warhead is a shaped charge that weighs approximately 100 pounds.[23]

NUWC Division Keyport

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[22] *Submarine Review October 1997- Post WWII Launched/ Lightweight Torpedoes* by Frederick J. Milford

[23] *www.chinfo.navy.mil/navpalib/factfile/weapons/wep-torp.html* General Characteristics of the Mk46, Mk-48, Mk-50 torpedoes and the ASROC Mk 46 Mod 5

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www.chinfo.navy.mil/navpalib/factfile/weapons/wep-torp.html General Characteristics of the Mk46, Mk-48, Mk-50 torpedoes and the ASROC Mk 46 Mod 5