

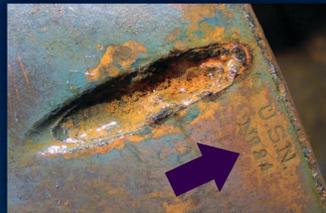
HOWELL MARK I TORPEDO NO. 24

DISCOVERY - HISTORY - RESEARCH - CONSERVATION

KATE MORRAND, Naval History & Heritage Command
 CLAUDIA CHEMELLO, Terra Mare Conservation LLC
 PAUL MARDIKIAN, Terra Mare Conservation LLC



RIGHT: A specially-trained Atlantic bottlenose dolphin "system" from the U.S. Navy Marine Mammal Program (NMMP).



LEFT: The numbered stamp (indicated by arrow) on the forward edge of the after body section. In addition to No. 24, there are two surviving Howell Mark I torpedoes located at the NHHC Naval War College Museum and the NHHC Naval Undersea Museum and numbered No. 18 and No. 35 respectively.



RIGHT: Howell Mark I torpedo No. 24 arrives in Washington D.C. aboard a C-130 transport aircraft. Weighing more than 400 lbs (181 kg) at recovery and measuring over 6 ft (1.8 m), custom-built crates were needed for its transportation.

HISTORY OF HOWELL MARK I TORPEDO NO. 24

Following the arrival of No. 24 at the Naval History and Heritage Command, the Underwater Archaeology Branch (UAB) immediately began conducting archival research in an effort to understand how this unique naval weapon became buried beneath the sea floor off the San Diego coast.

U.S. Navy archival records revealed that only fifty Howell Mark I torpedoes were ordered from the Hotchkiss Ordnance Co., RI in 1895. The experimental mission of the Howell Mark I torpedo coupled with notable features observed on the artifact itself (e.g. the remains of an activated signal flare canister in a cavity of the middle body) led UAB to hypothesize that No. 24's loss likely occurred during a training exercise.

In 1896 and 1897, eight U.S. Navy ships received these experimental weapons for testing however only five of these vessels spent time near the California coast. Poring over historical ships logs from these five vessels led UAB to discover some telling entries from the 1899 log book of U.S.S. *Iowa* (BB-4) which helped establish the provenance of No. 24.

On 18 December 1899, *Iowa* anchored off San Diego and proceeded to conduct target practice. And just a few days later on 20 December 1899, the following entry was made in *Iowa's* deck log: "...Target practice with torpedoes. Lost H. Mark I, No. 24 torpedo..."

DISCOVERY OF HOWELL MARK I TORPEDO NO. 24

In March 2013, the middle and afterbody sections of Howell Mark I torpedo No. 24 were discovered off the coast of San Diego by a human/dolphin team from the U.S. Navy Marine Mammal Program (NMMP). Using their highly sophisticated biological sonar and ability to make repeated deep dives, Atlantic bottlenose dolphins are trained by the Navy to search for, detect and mark underwater objects, some of which may pose a threat to U.S. Navy divers, vessels and the public. Following location by NMMP systems, U.S. Navy divers relocated and recovered two sections of the as yet unidentified torpedo. Additional efforts were made to locate and recover the third section or "nose cone" however it was not found in the immediate area.

At recovery, the weapon was considered potentially live and a Navy Explosive Ordnance Disposal (EOD) team was called in to examine and, if necessary, inert it. Upon closer inspection, the EOD team discovered a stamp on the forward edge of the after body section reading "U.S.N. No 24" indicating that the ordinance belonged to the American Navy. Further investigation identified the weapon as a Howell Mark I torpedo, a historical Navy-designed experimental model dating to the late 19th century. The team then reached out to the Naval History and Heritage Command (NHHC) and coordinated transportation of the torpedo to NHHC headquarters in Washington D.C. for conservation treatment and further research.



ABOVE: Howell Mark I torpedo No. 24 middle body section in treatment, December 2013.



ABOVE: Howell Mark I torpedo No. 24 after body section in treatment, December 2013.

CONSERVATION OF HOWELL MARK I TORPEDO NO. 24

After more than a century underwater, the middle and after body sections of No. 24 were largely well preserved however it was clear that extensive conservation treatment would be required to ensure the immediate and long-term preservation of the artifact. Further, No. 24 is a large, rare and complex artifact composed of multiple materials, each with specific treatment requirements to render them stable. For such an important project, the Naval History and Heritage Command (NHHC) contracted Terra Mare Conservation, LLC through Southeastern Archaeological Research Inc. (SEARCH) whose archaeological conservators and co-founders Paul Mardikian and Claudia Chemello have extensive experience working with complex archaeological artifacts.

Shortly after the arrival of No. 24 at NHHC, treatment of both the middle and after body sections began with ongoing desalination in circulated baths of de-ionized water and sodium carbonate solution along with careful measurement and monitoring of chloride levels. The conservation team has employed a number of techniques and tools for de-concretion and mechanical cleaning of both the middle and after body sections. Chemical cleaning of the artifact surface has also been successfully achieved through immersion in baths of dilute anionic surfactants and corrosion inhibitors. Successful mechanical cleaning requires conservators to have access all available areas of the artifact therefore partial disassembly of specific areas of the torpedo has been necessary. To access the interior of the middle body, conservators dismantled the section's forward bulkhead and systematically excavated and carefully removed over 80 lbs (36 kg) of sediment that had accumulated inside.

A particularly challenging aspect of the project has been the cleaning and treatment of the 130-lb (59-kg) steel fly-wheel located in the aft portion of the middle body section. The middle body has been too physically distorted to allow the removal of this component and so conservators must treat it *in situ*. The substantial supports surrounding the fly-wheel further impede access to this vital area. The conservation team has employed mechanical cleaning and rinsing along with a custom-designed electrolysis unit to further clean and stabilize the fly-wheel.



ABOVE (TOP): Terra Mare conservator Claudia Chemello carefully excavates sediment around the depth register pocket inside the middle body section of Howell Mark I torpedo No. 24.

ABOVE (BOTTOM): Terra Mare conservator Paul Mardikian mechanically cleans the starboard gear frame on the after body section of Howell Mark I torpedo No. 24.

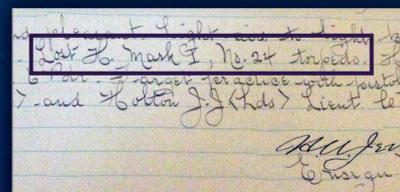
RIGHT: Interior of the signal flare cannister located in the middle body of Howell Mark I torpedo No. 24. The cannister was originally filled with calcium phosphide, a compound which reacts with water to form highly combustible phosphine gas. Prior to releasing the torpedo, sailors punched holes in both ends of the cannister to allow water to penetrate during the run and initiate the reaction. The bubbles of phosphine gas produced then floated to the surface, combusted and emitted a bright orange flame thus providing an efficient way to track the torpedo during a training exercise.



RIGHT: Photograph of U.S.S. *Iowa* in New York harbor during the Spanish-American War, August 1898. Image courtesy of NHHC Photo Archives.

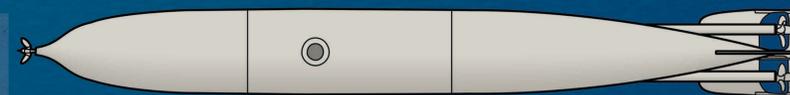


RIGHT: Excerpt from the deck log of U.S.S. *Iowa* indicating the loss of Howell Mark I torpedo No. 24 on 20 December 1899.

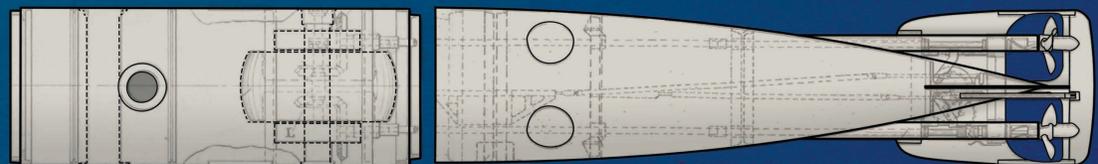


AMERICAN INNOVATION OF THE STEAM-POWERED TORPEDO

Developed in 1870 by U.S. Navy LTCDR John Howell, the Howell Mark I torpedo was the first self-propelled steam-powered torpedo of American design. It was also smaller, lighter, faster, longer-running and carried more explosive material than competing models produced in Britain. And while many contemporary torpedoes utilized internal compressed air engines, the Howell was powered by a 130-lb (60-kg) steel fly-wheel located in the middle body section. An on-deck steam turbine accessed the fly-wheel through a clutch in the side of the middle body section and spun it up to 10,000 rpm which allowed for a maximum speed of 25 knots over a 400 yard firing range. The motion of the fly-wheel created a gyroscopic effect that helped the torpedo maintain a straight course throughout its run while producing very little wake. In 1899, the U.S. Navy ordered fifty Howell Mark I torpedoes from the Hotchkiss Ordnance Co. however a different model was ultimately purchased and the Howell was never mass produced.



ABOVE: Schematic of Howell Mark I torpedo after plates published in the General Description of the Howell Torpedo published by the Bureau of Ordnance, 1896.



ABOVE: Fly-wheel viewed looking aft into the middle body section of Howell Mark I torpedo No. 24. The gear shafts are visible on either side of the fly-wheel.



ABOVE: 1895 Photograph of torpedo boat U.S.S. *Stiletto* firing a Howell torpedo from its on-deck tube. Image courtesy of Naval History & Heritage Command Photo Archives.

LEFT: Scott Storms, an engineer from the Naval Surface Warfare Center (NSWC-CD) uses a Creaform 3D Laser Scanner to document Howell Mark I torpedo No. 24. NSWC-CD engineers will utilize the scan data to produce a 3D digital model of the torpedo for research, documentation and outreach purposes.



Underwater Archaeology Branch
 Naval History and Heritage Command
 Department of the Navy

Washington Navy Yard, DC
<http://www.history.navy.mil/ua>
 NHHCUNDERWATERARCHAEOLOGY@navy.mil

Terra Mare Conservation
 Archaeology Architecture Fine Art Industrial

Terra Mare Conservation, LLC
 Charleston, South Carolina



Southeastern Archaeological Research, Inc.
 Orlando, FL - www.searchinc.com